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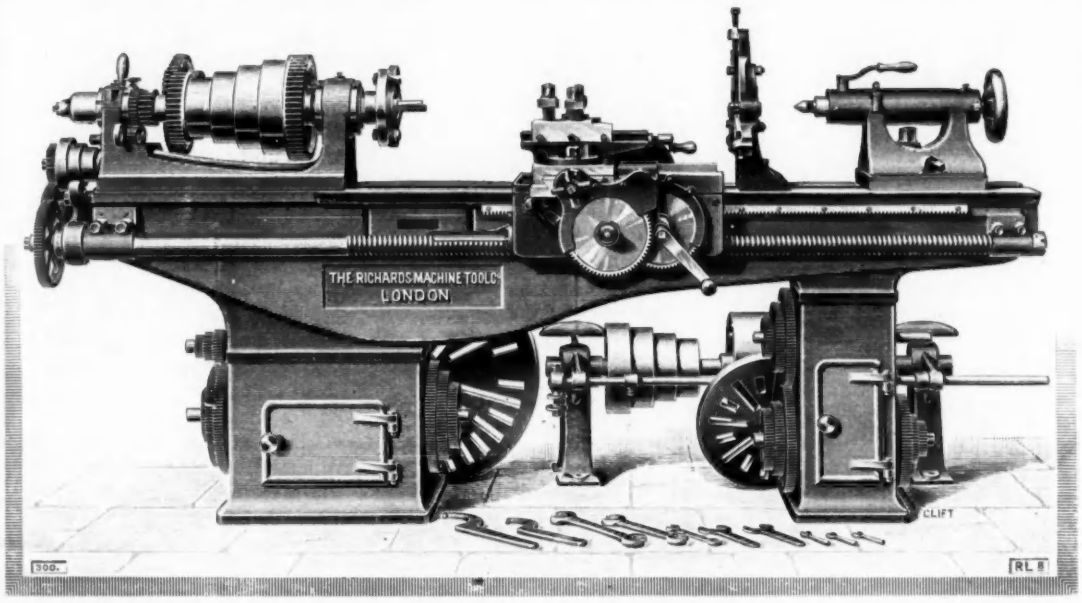
An English Lathe.

In connection with the discussion going on in our columns as to the relative merits of the American and the English lathe, the machine which we illustrate herewith ought to prove interesting, because it, in a sense, represents English practice. It is not, however, a strictly typical English lathe, but embodies some features of American practice, and considerable of the originality and boldness of its designer, Mr. Geo. Richards, its builder being The Richards Machine Tool Co., Suffolk House, Laurence Pountney Hill, E. C., London, England.



The lathe, as shown by the perspective engraving, is called in its own country an 8 inch center, screw-cutting, sliding and surfacing lathe. Here we would call it a 16-inch engine lathe.

Its bed, as will be noticed, is peculiar in outline, and follows somewhat the lines of Professor Sweet's lathe of the same size, which we illustrated and described in our issues of May 30, June 6, 13 and 20, July 4 and 18, 1889.

The sectional engravings, Figs. 2 and 3, show that it is of the box form, and though somewhat expensive to mold, especially as its form is such as would make it necessary to have a complete new pattern for every different length of bed, it is, no doubt, very strong to resist deflection and twisting in proportion to its weight.

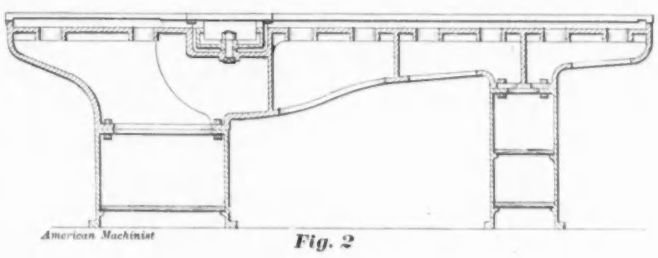


Fig. 2

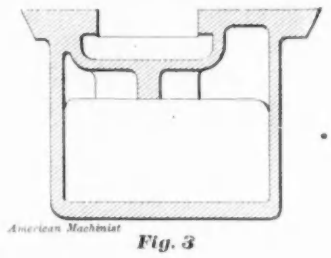


Fig. 3

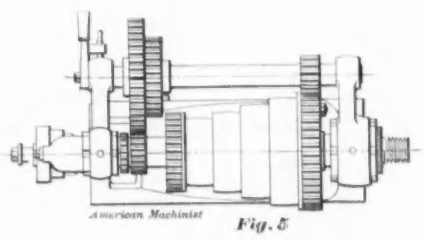


Fig. 5

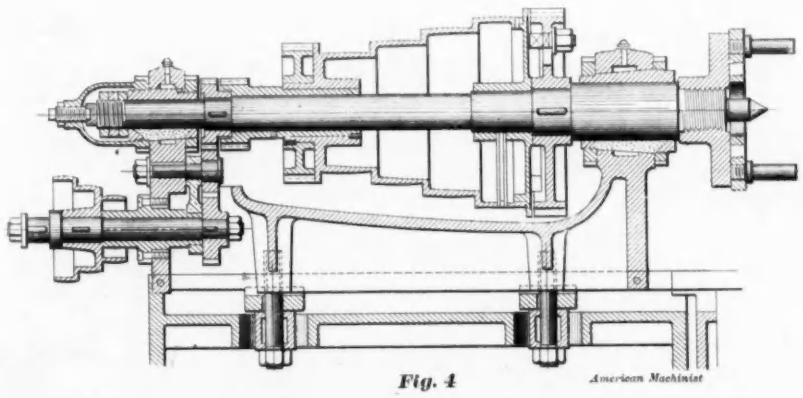


Fig. 4

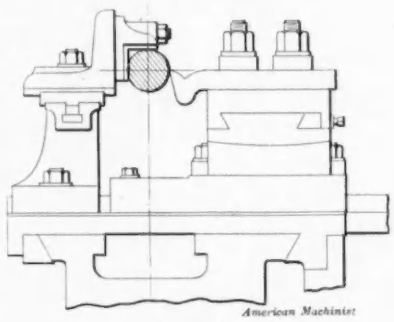


Fig. 8

It is not so deep as it looks just in front of the head stock, however, because it has what most good Englishmen think is essential—a gap, which in the engraving, Fig. 1, is filled with a gap piece, over which the carriage can slide. The makers claim that the only practical objection to the gap is the weakening of the bed. If this were all, it would be easily overcome, and we think the builders have overcome it, but it seems to us there are still some objections to it, which cannot be overcome, and among these is the necessity for arranging the cross slide of the carriage very near the left side, so that the pressure caused by the cut is very badly distributed upon the carriage and ways, and placing the lead screw so low to avoid interfering with the gap that it is too far from the slides and from the tool.

This one-sidedness of the carriage makes the projecting sleeve over the tail-stock spindle necessary, and makes the beginning of a cut upon a shaft always about twice as far from the bolt and clamp which hold the tail stock in place, as would otherwise be necessary. These are, however, regular features of English practice which seem to be satisfactory there, but would certainly not meet with favor here.

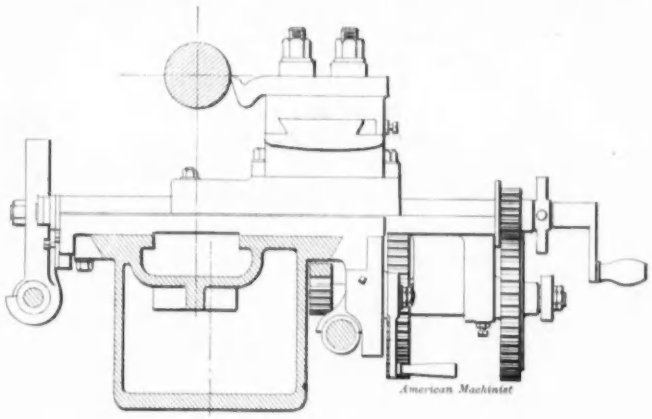


Fig. 6

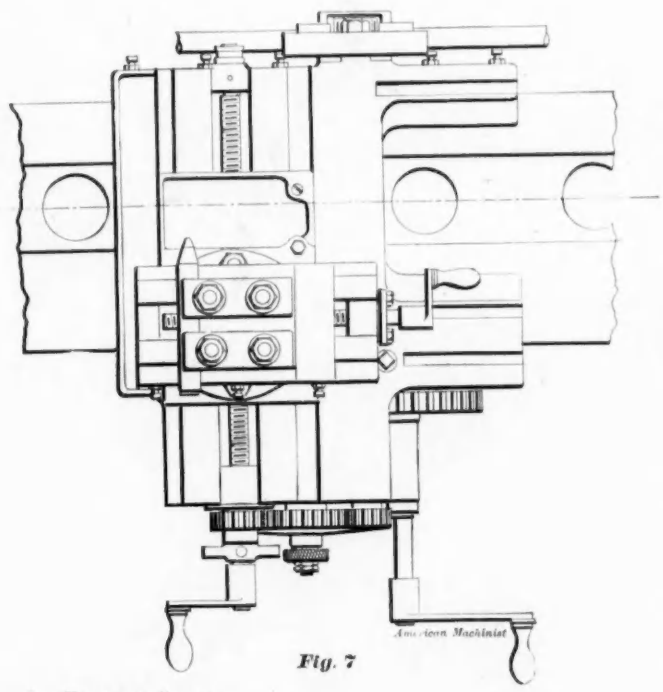


Fig. 7

AN ENGLISH LATHE.

The head stock which we show in Figs. 4 and 5 does not differ very radically from head stocks which can be found here, though hollow spindles are now usually demanded here, and a hole through the spindle would involve some changes in the arrangement for carrying end thrust. The length of this spindle from outside to outside of bearings is 2 feet 4 inches, and the front bearing is 3 inches by 5 inches. The spindle is confined endwise entirely by the rear bearing leaving the other free for expansion and contraction of spindle, and both boxes are conical sleeves split and adapted to be taken up by means of threaded collars. Felt is placed in an opening at the bottom to hold oil. It will be noticed that there are two ratios of back gearing, one of these being 9 to 1, the other 3 to 1. The two large gears on the back gear quill are keyed to a sliding

sleeve, and in the position shown, Fig. 5, are in gear for the 9 to 1 reduction. By sliding the gears to the right, the larger gear on the cone pulley, and the smaller of the two others, are engaged, these being of the same size. This enables the differences in diameter between the several steps of the cone to be much smaller than usual, and the smallest step much larger than usual without lessening the total range of speeds.

The method of transmitting and reversing the feed motion is by the familiar tumbling gears.

Figs. 6 and 7 show the carriage, and that the slides for cross feed and compound rest are much wider and more substantial than it is the practice to make them here, and placing the feed rod behind the lathe, and transmitting motion from it by worm gears and shaft extending to the front, is also radically different from our practice, but it gets the rod clear of the gap without getting it entirely below the bed of the lathe, which latter might be necessary if it were carried in front.

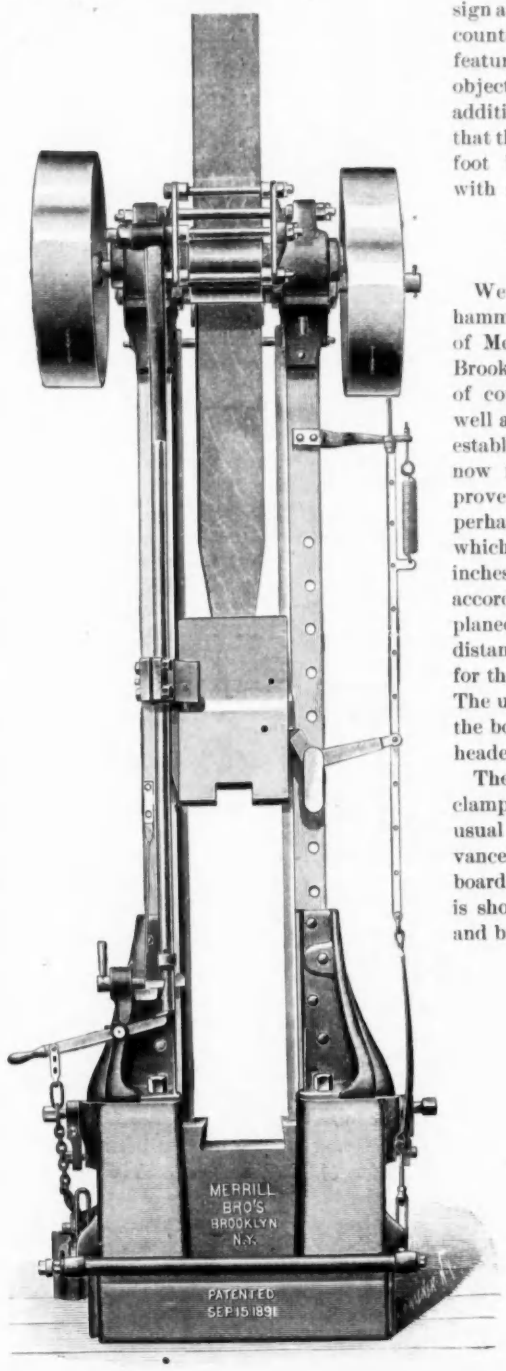
We are aware that it is claimed that the top surfaces of this form of lathe bed are not worn appreciably by the carriage, but, nevertheless, we should expect some wear of the bed to take place, and usually more of it close to the head than elsewhere. It will not wear as rapidly as our much smaller Vs under the same pressure and service, of course, but when wear does take place on top it will affect the fit of the carriage sideways upon the bed independently of the wear which may take place on the inclined sides themselves, which, of course, will add to the difficulty.

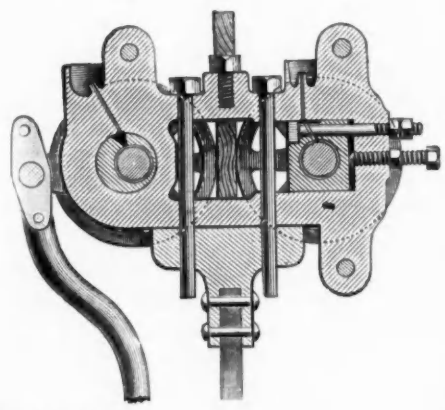
Our practice of having a "set over" to the tail stock for adjusting it, or for turning tapers, has been very much criticised and is not generally followed in England, the lathe we illustrate being "Yankee" in that respect. We do not understand how with the form of bed adopted the tail stock can be moved from place to place on the bed and always be in line when clamped, unless it fits so closely between the vertical surfaces shown in Fig. 6 as to make it very difficult to move it along the bed. An American particularly likes to have his lathe tail stock move easily and yet retain its alignment when once set.

The steady rest furnished with the lathe is strictly American in design, but as will be seen by Fig. 7 the tool cannot be brought close up to it when the rest is between the carriage and head without overhanging the carriage entirely.

The follow rest, or "back stay," is shown in Fig. 8 and sufficiently explains itself. Those usually supplied with lathes in this country are much cheaper to make, but are not so good.

In commenting upon the features of this lathe we have in mind the fact that the skillful designer adapts his machine to the conditions under which it is to be built, sold and used. We criticise the lathe from the American standpoint entirely, not doubting that were we in England and required to design a lathe to be built, sold and used in that country it would contain at least some of the features of this one which we now consider objectionable, and perhaps many others in addition. It may be interesting to note that the price of this lathe as shown with 8-foot bed is about $500, our money, and with a bed 10 feet long, $30 more.





IMPROVED DROP HAMMER.

An Improved Drop Hammer.

We present herewith engravings of a drop hammer which represents the latest practice of Merrill Brothers, 465–471 Kent avenue, Brooklyn, N. Y. The Merrill hammer is, of course, very well known in foreign as well as U. S. armories and other industrial establishments, but the hammer which we now illustrate embodies some recent improvements, the most notable of which perhaps is the wrought steel uprights, which consist of flat bars of rolled steel 2 inches thick, and 6 inches or 8 inches wide, according to the size of hammer. These are planed upon the inner edges and for some distance on the sides to form suitable guides for the hammer, which is of wrought-iron. The uprights are fitted to heavy castings at the bottom by rivets which are driven and headed cold in drilled and reamed holes.

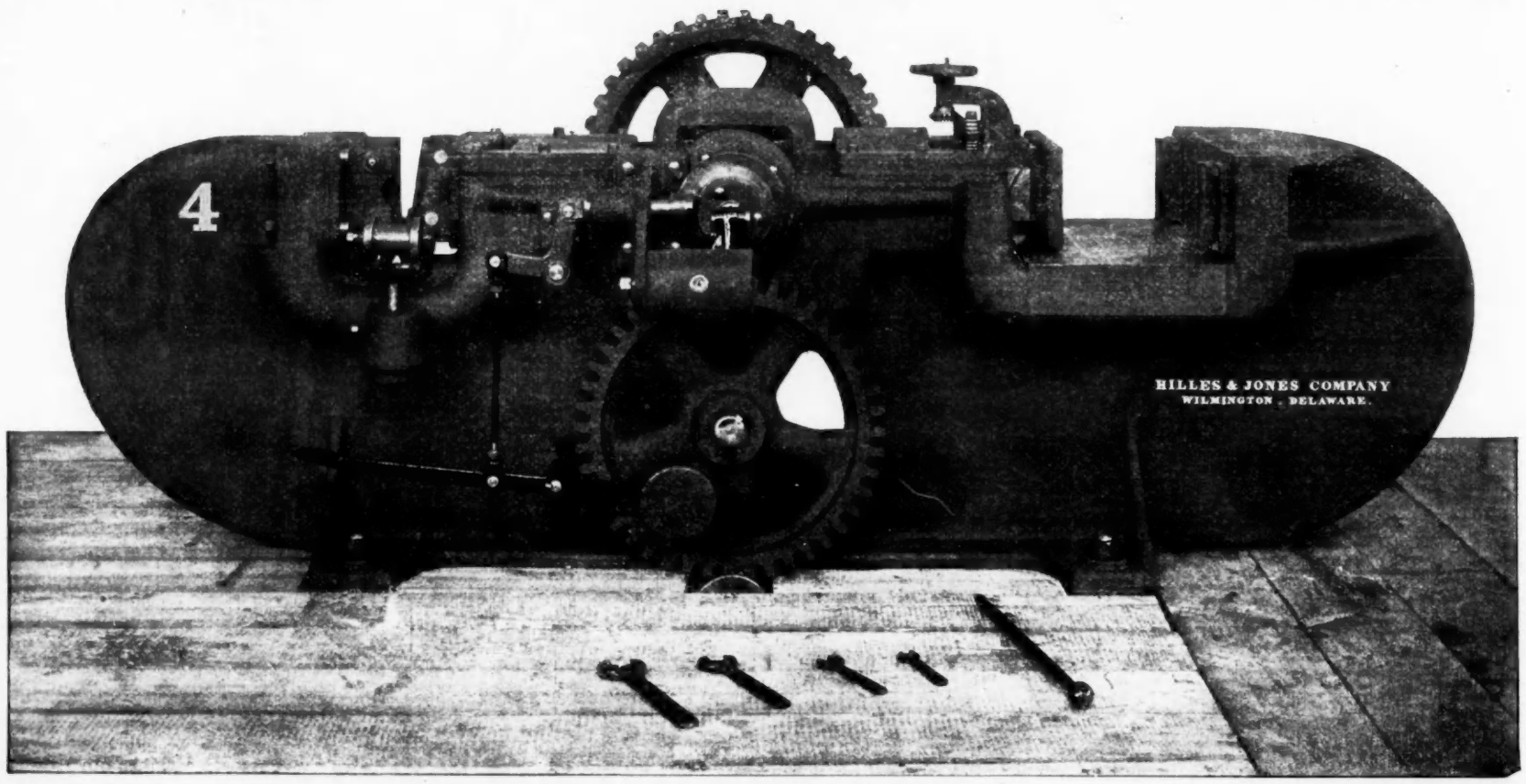
The hammer is raised by a board which is clamped between friction rollers in the usual way, one of these rollers being advanced toward and drawn away from the board by means of eccentrics, one of which is shown in the sectional view of the head, and both of which are moved by connection to a swinging frame which is rigid enough to insure uniform movement of the eccentrics, and is actuated by the vertical rod at the left, the weight of which is sufficient to give the required contact. When this rod is raised by the hand lever or the foot treadle the board is disengaged and the hammer falls; by timing the release of pressure by the foot it is caught upon the rebound and immediately rises again, or it may be either entirely stopped or retarded just before striking, the experienced hammermen whom we have seen handling the hammers seeming to have them under perfect control. For instance, any desired number of light blows can be struck, the hammer rising only slightly from the work, and these may be followed by a blow of maximum force, or *vice versa*, the hammer following exactly the motion of the hammerman's foot. When the hammer rises to its full hight it is retained by the lock seen on the right-hand upright, which is first detached by the downward movement of the treadle.

Special attention has been paid to simplicity of construction, and to so fastening the various portions of the mechanism together as to reduce the familiar disintegrating effects of repeated blows to a minimum, experience of the Merrill Brothers themselves, and of users of the hammer having been the guide. This hammer is regularly made in seven different sizes with weights of hammers varying from 300 to 1,800 pounds, with from 8 inches to 18 inches space between uprights, and with lifts from 3 feet 10 inches to 6 feet. It is also made of special proportions for special work.

Horizontal Punching, Shearing and Bending Machine.

We present herewith an engraving of a combined machine for punching or shearing at one end, and bending angles, channels, or other sections of bars at the other end. The capacity of the punching end of the machine is equal to punching $1\frac{5}{16}$-inch holes in $1\frac{1}{4}$-inch plate, or cutting off $2\frac{1}{4}$-inch square bars.

The machine is double-geared, with large and substantial bearings, and is self-contained on one foundation. Where desired, the first driving shaft can be run under the floor so that the machine can be entirely clear of belts. The clutch can be worked either with an improved adjustable automatic stop, or a plain hand and foot lever.



HORIZONTAL PUNCHING, SHEARING AND BENDING MACHINE.

There is a pair of adjustable rollers for convenience in handling bars, and the edges of the housing on the bending end are planed so that tables of any character can be con

veniently attached. Total weight of this machine is about 25,000 pounds. It is made by the Hilles & Jones Co., Wilmington, Del.

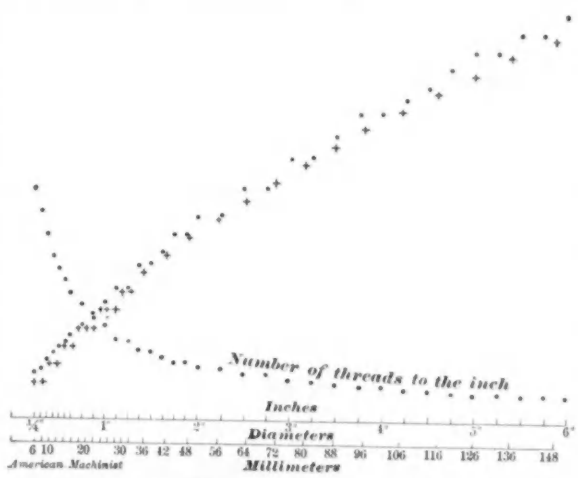
French Standard Screw Threads.

In an editorial in our issue of April 25th we spoke of the American standard of screw threads, and of the considerations by which its details were determined, and which secured its adoption. While it is easily shown that other pitches (usually finer) may be better in special cases, the pitches adopted, and also the shape of the thread, seem to be most applicable or acceptable for the greatest number of conditions, or combinations of conditions. The following account, which we reproduce from *Engineering*, of the movement in France toward the adoption of a standard system of screw threads will be found of interest in this connection. In the diagram herewith we have devised a means of comparing the American standard with that of the French marine, and the most notable result of the comparison is the close approximation of the French system to our own, showing, apparently, that our ratios of pitch to diameter are nearly those of the most preferred practice everywhere. It will be noticed in the description of the French system that the shape of the thread adopted is identical with the American, though our English contemporary neatly avoids saying so.

The base line of the diagram indicates the outside diameters reduced one-half by our limits of space. The series of dots and crosses rising from near the lower left-hand corner indicate by their vertical distance above the base line the pitch of the individual thread for the given diameter, the dots indicating the American pitch, and the crosses the French. The vertical scale is five times that of the actual pitch. The dots descending toward the right from the upper left of the diagram indicate by their hight from the base line the number of threads to the inch in the American system. The scale is an arbitrary one, and has no significance. In the French system the pitches adopted are not aliquot parts of any larger unit of measurement, so that our mode of stating the pitch as so many to the inch has no counterpart in that system. The following is the article referred to from *Engineering*, of London:

FRENCH STANDARD SCREW THREADS.

The Société d'Encouragement pour l'Industrie Nationale has long been agitating for the adoption of a standard thread in France. Hitherto, there has been a multiplicity of threads; the navy has one, each large railroad company has another, and many manufacturers have prided themselves that nuts produced by their rivals would not screw on to the bolts they turned out. It seems, however, as if the end of this confusion were in sight, for the Minister of Marine has formally notified the society that he has decided to adopt in principle their system of screw threads. He has also addressed a circular to the vice-admirals, maritime prefects, and directors of establishments, enjoining the use of the new system. According to this circular the thread of a mechanical screw is formed by the truncation of a triangle whose base, parallel to the axis of the screw, is equal to the pitch of the screw. The male and female screws have in principle the same thread, but, to provide a working clearance, both male and female screws are cut away below their theoretical profiles; in other words, the reduction to provide clearance is applied to the threads both of the bolt and nut, and not to either one alone. The amount of play or clearance is not set forth, each constructor being left to use his own judgment in the matter according to the conditions under which he works. The thread is an equilateral triangle. The base and the apex of the triangle are cut off by two lines parallel to the axis of the screw, and situated one-eighth of the hight of the triangle from the base and apex, respectively. In this respect the new screw follows the existing French marine practice. The circular explains that although the angles of the threads are theoretically sharp, yet in practice they prove to be more or less rounded, according to the degree of finish in their execution. This rounding, however, must not cause either the male or female screw to exceed the common surface limit fixed by the rule above. The diameter of a screw is measured over the points of the thread after they have been truncated. This is a departure from the marine practice of assuming the diameter to be equal to that of a cylinder inclosing the points of the threads, supposing them not to be cut away. The following table gives the standard screws adopted by the French marine; it includes the series got out by the Société d'Encouragement with certain others intercalated to meet the requirements of the service:



COMPARISON OF FRENCH AND U. S. SCREW PITCHES.

TABLE OF STANDARD SCREWS. (SYSTEME FRANCAIS. S. F.)

Diameter.		Pitch.	
Millimeters.	Inches.	Millimeters.	Inches.
6	.236	1	.0394
8	.315	1	.0394
10	.393	1.5	.059
12	.472	1.5	.059
14	.551	2	.0787
16	.629	2	.0787
18	.708	2.5	.0984
20	.787	2.5	.0984
22	.866	2.5	.0984
24	.945	3	.1181
26	1.023	3	.1181
28	1.102	3	.1181
30	1.181	3.5	.1378
32	1.260	3.5	.1378
36	1.417	4.0	.1575
42	1.654	4.5	.1772
48	1.890	5	.1969
56	2.205	5.5	.2166
64	2.520	6	.2362
72	2.835	6.5	.2559
80	3.150	7	.2756
88	3.465	7.5	.2953
96	3.779	8	.3150
106	4.17	8.5	.3347
116	4.56	9	.3543
126	4.95	9.5	.3740
136	5.35	10	.3937
148	5.82	10.5	.4133

If it becomes necessary to make a screw of an intermediate size, it must be of an even number of millimeters in diameter, and of the pitch of the principal screw immediately below it.

The bodies of screws and bolts are rather larger in diameter than the screwed part. The limit of this excess is as follows:

.5 millimeter for screws from 6 to 14 millimeters in diameter.

1 millimeter for screws from 16 to 48 millimeters in diameter.

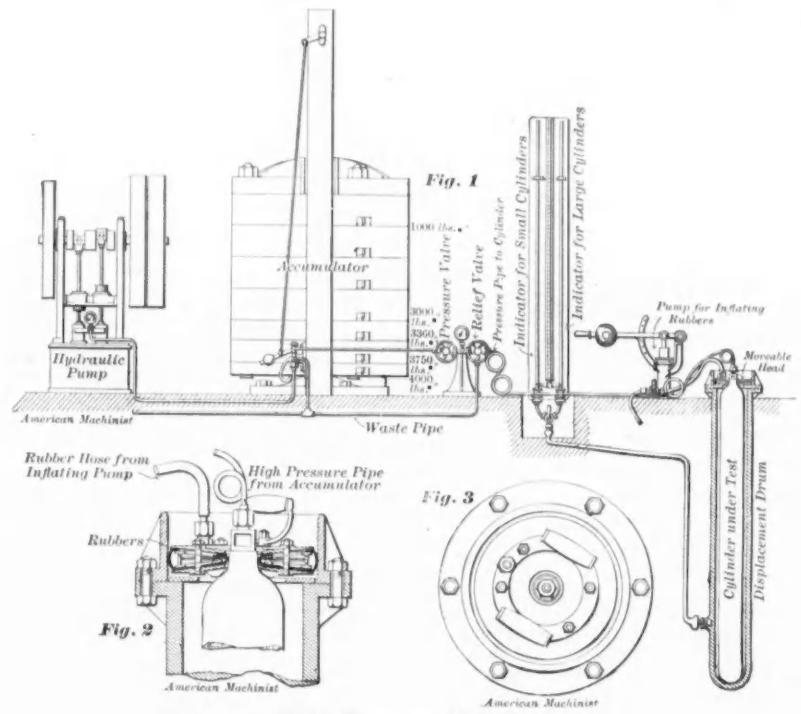
2 millimeters for screws more than 48 millimeters in diameter.

Nuts and the heads of bolts of usual forms, hexagonal and square, are inscribed in a circle whose radius is equal to the diameter of the screw. The inclination of conical heads is 9 horizontally to 10 of hight, which corresponds to a summit angle of about 84 degrees. The thickness of the head is not definitely fixed, but the usual thickness equals the diameter of the screw. Further, the dimensions of capstan pin holes, union nut notches, and screw-driver gates are variable; it is recommended to make the width of the gates and the diameter of the holes twice the pitch of the thread, and the width of the notches entire multiples of the pitch.

Watchmakers' screws are not included in the new regulations, but the *série dite Thury*, adopted in several countries upon the suggestion of the Société des Arts de Genève, is recommended in cases where choice is possible. The Minister of Marine has decided that, from January 1, 1896, orders for machines of all kinds will specify that the screws, bolts, etc., shall conform to the French system as adopted by the marine. This will oblige all manufacturers who desire to obtain orders for the navy to conform to this standard, and will have the effect of rapidly introducing it.

Testing High-pressure Gas Cylinders.

We herewith reproduce from *Engineering* a cut of an apparatus for testing the cylinders used in the transportation of gases, which should be of interest to many of our readers as mechanics, and whether connected with this line of industry or not. The business of gas compression, storage and transportation is now an established and extensive and, like everything else, also a growing one. In this country, the most extensive transportation of gas is that of the carbonic acid for soda fountains. Illuminating gas is compressed, not generally, however, to high pressures, for railroad cars. With our growing civilization the use of the other gases, oxygen, hydrogen, nitrogen, etc., is daily becoming more common, and it is requisite to transport them everywhere. Compressed air is also widely used for temporary or portable service at very high pressures, and the cylinders or receivers for these various uses constitute when charged a danger that requires all practical safeguards. It is obvious that every cylinder should be tested by hydrostatic pressure to a point considerably above that to which it is to be charged with the gas, and this has always been done, but in spite of it frequent accidents have occurred. It has undoubtedly happened that in testing the cylinders by internal pressure, and in the desire to make them register as high as possible, the test has been carried beyond a safe point, and the elastic limit for the material has been exceeded. As a precaution against this occurrence, the present apparatus has been devised and is in use by the Scotch and Irish Oxygen Company, of Glasgow.



TESTING HIGH-PRESSURE GAS CYLINDERS.

The primary object of this apparatus is to obtain an insight into the behavior of cylinders whilst under hydraulic test pressure, for it was feared that, under the old manner of treatment, many cylinders were being ruined by excessive testing, and were being stretched beyond their elastic limit; this was found to be the case, and faults are now shown, and cylinders rejected, which would otherwise have been considered suitable for service.

The cylinder to be tested is filled with water and placed in the displacement drum, which is also filled with water. The joint ring cover is then put into place, and its joint surfaces inflated around the neck of the cylinder to make a tight joint. It is necessary, in order to obtain correct readings, that the pressure in the inflating rubbers of the joint ring should be constant, and, where a fixed head of water is not obtainable, this is managed by means of a weighted piston, as shown. The cylinder is next subjected to internal pressure, and its expansion is measured by the displacement of water from the displacement drum. The water immediately commences to rise in the gauge glass on the first indication of pressure on the pressure gauge, and continues to do so until the maximum pressure is reached, on release of which it falls, with good cylinders, to its original position, showing that the elastic limit of the metal has not been passed, and that the cylinder is in no way damaged. Two gauge tubes are shown of different diameters, one being for cylinders of small, and the other for cylinders of large capacity, connection being made with either, as desired, by means of a threeway cock. The pressure accumulator is loaded with rings of cast-iron in such a manner that the different pressures required may, without trouble, be obtained by using any number of rings.

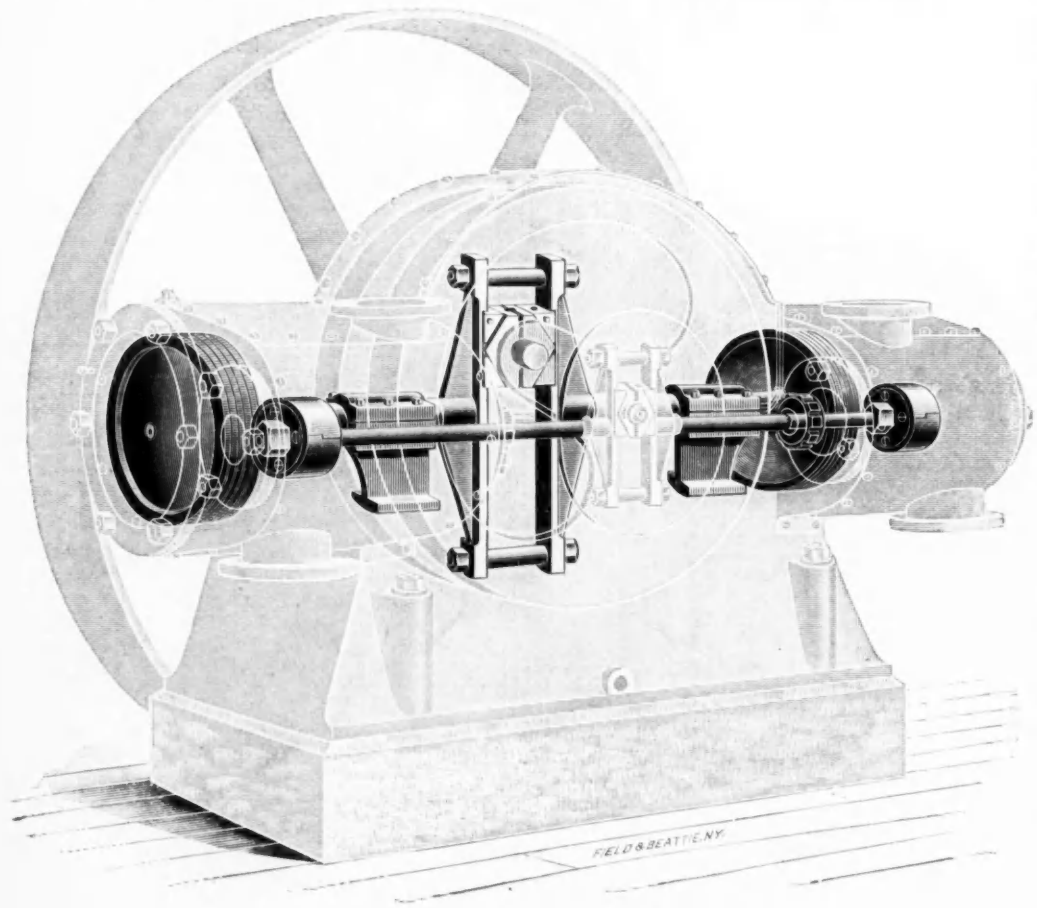
After passing the ordeal of this apparatus, we might reasonably assume that the cylinders were safe. Attention is now called to another danger that may still accompany them, and which calls for an additional test. It is important that the cylinders should be practically tested for brittleness by a series of blows with a hammer during the time when the maximum hydraulic pressure is applied internally. Accidents have occurred through charged cylinders being dropped from a workman's shoulder, although a previous high hydraulic pressure had been sustained. In all such cases it has been found on testing that the material was too brittle. In England, the railway authorities insist upon knowing the percentage of carbon, and that it shall be low in these cylinders, to avoid possible failure through brittleness from rough handling by careless employes. Compressed gas firms who apply the above practical test, find that a fair percentage of cylinders fail to pass this ordeal.

A practice that must appear to be improper, but which is almost universal, is in the shipment of highly charged cylinders without any form of safety valve upon them. If the cylinders are filled at the factory from a receiver maintained at a somewhat higher pressure, the temperature of the contents of the cylinder at the termination of its charging will be somewhat below the normal temperature of the works; if filled by imme-

diate pumping the temperature is not likely to be below, but may be somewhat above the normal. But in transit these cylinders may be exposed to the sun, and the temperature of the contents may be raised 50 degrees above the temperature at which they were charged, with the corresponding increase of pressure. It is well known that explosions have occurred from this cause.

A Novel Steam Engine.

As a novelty in the line of steam engineering we illustrate upon this page an engine made by W. D. Forbes & Co., Hoboken, N. J. They say that it has been brought out with the idea that, generally speaking, the fewer parts there are to a mechanical apparatus, the less liable it is to wear out of line, or to get out of order, and so the working parts of this, according to their enumeration, are but five: pistons, valves, crank, crank brasses and valve brasses. The steam cylinders are each single acting. The main yoke forms part of the piston rod, as the valve yoke is also a part of the valve rod. The valves work in linings which may be renewed if cut or injured. The main crank pin is between two balanced crank disks, so that the shaft runs quite smoothly. The engine, as will be seen, is very compact, and requires a comparatively small floor space. The cut shows a single-acting engine; they are also made double acting. Engines 9″x8″ and 12″x12″ are already made. They have been run satisfactorily at from 245 to 600 revolutions.



A NOVEL STEAM ENGINE.

Cheap Fuel—II.*

SOME THOUGHTS UPON THE ECONOMICAL PRODUCTION OF STEAM, WITH SPECIAL REFERENCE TO THE USE OF CHEAP FUEL, BY A MINER OF COAL.

I now proceed to the second part of my paper, a description of a furnace with which I have been experimenting, and in which I have sought to place the fuel in the conditions which a series of experiments made by us at Drifton seem to indicate to be those in which the smaller sizes of anthracite coal can best be burnt. Four years ago the State of Pennsylvania appointed a commission, of which I was one, upon the question of utilizing the waste products of our anthracite mines. One of the most important problems was what could be done with the small sizes, of which large quantities were being thrown away.

I began a series of experiments in burning the smaller sizes of anthracite coal with both fan and steam jet blast. The experiments were made in a furnace 3 feet long, 2 feet wide, on grates of various kinds. The coal and ash were in all cases analyzed and weighed. The experiments showed:

First. That the ashes produced by a steam jet were never as low in carbon as those produced by the fan, or the fan blast realized a larger per cent. of carbon from the same coal.

Second. With the fan blast the rate of combustion per square foot is greater.

Third. Where a bed of coal is ignited and burnt out the percentage of carbon in the ash is less than where coal is successively added to the burning mass.

Fourth. The introduction of steam into the ash pit decreases the tendency of the coal to clinker. It also changes the flame, and, owing to the producer action, makes the flame extend further beyond the bridge wall. In many cases it is difficult to fire without the steam jet on account of the clinkering.

Fifth. The burning of culm, or the small coals with dust in them, leaves a high percentage of carbon in the ash, analysis showing as high as 58 per cent. The red hot culm acts like dry sand and runs down into the ash pit. If coal is to be transported far it is cheaper to remove the dust at the mines and transport only the larger coal.

Sixth. The percentage of iron pyrites increases rapidly with the smallness of the coal, because they occur in thin layers or incrustations of the coal. Iron pyrites are very undesirable as they destroy the grates and other iron work and increase the tendency to clinker.

Seventh. While the fan blast gives a more perfect and rapid combustion the steam blower is often preferable on account of the clinkering.

Eighth. Mixing different coals may make trouble, as two coals which burned separately are reasonably satisfactory, when mixed may clinker.

Ninth. Small anthracite burns more perfectly if undisturbed, instead of being turned over, mixing the consumed and the unconsumed coal together.

The temperature developed decreases with the size of the coal, necessitating increased boiler surface. If burning pea coal and getting 1 horse-power for 9 square feet of heating surface, probably 20 or 25 per cent. more surface would be required for No. 3 buckwheat, although evaporating the same water per pound of combustible.

My furnace was designed, as far as possible, to fulfill these required conditions: To ignite the coal and burn it without mixing with fresh fuel; the combustion continuous and uniform; the work of firing as easy as possible, so that the man in control would have more work for brain than for muscle; the idea being that the coal would be conveyed and fed without hand labor, and the ashes be disposed of in the same way.

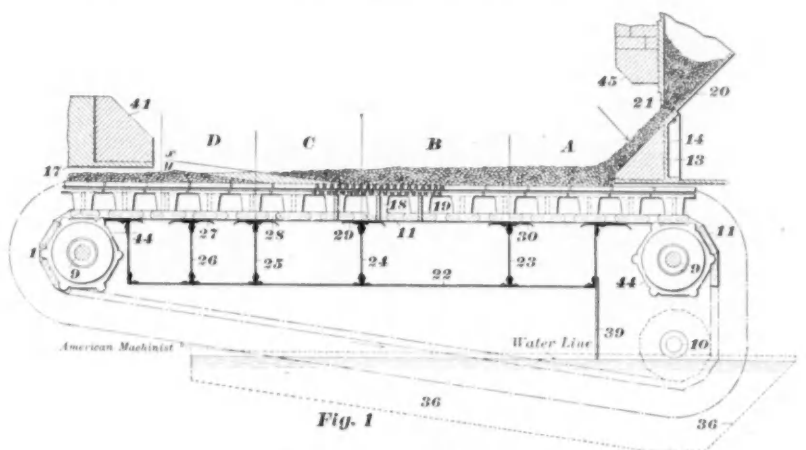


Fig. 1

MECHANISM OF FURNACE.

Fig. 1 is not an exact representation of the furnace as built, but is intended to explain its action. The essential feature of the apparatus is the traveling grate, moving from the right to the left. The coals feed by gravity from the hopper 20, over the fire brick 14, on to the traveling grate, moving at 3½ feet to 5 feet per hour.

The fire brick 14, or "ignition brick," is hot, and the coal sliding down over it becomes incandescent when it reaches the bottom, or before. Under the grate are a number of sheet-iron chambers closed except on top. The fan blast is blown into the large chamber, which is the second one to the right. The partitions between the chambers are covered by the horizontal plates 27, 28, 29 and 30 of such a width that in any position of the grate bars one is always resting upon the plate, and the air can only pass from one chamber to the next by leakage along the bar, and each successive chamber has a less pressure of air. The pressure in the first chamber to the right is less than in the big chamber, and when the coal arrives on the grate it has blast enough to ignite it, but not too strong to impede the ignition.

As the thoroughly ignited coal passes over the big compartment, it burns briskly over the third compartment, the thinner layer of partly consumed coal continually diminishing in carbon is subjected to less blast, and so on, until, finally, the hot ashes are cooled off by a gentle current of air, which is heated and mingles with the carbonic oxide produced in the zone of intense combustion *B*, and converts it into carbonic acid, the object being to subject the coal as soon as it arrives on the grate to a blast which is the proper one to ignite it, then burn it with a blast as strong as will produce good combustion, and as the carbon is eliminated and the bed gets thinner to diminish the blast correspondingly. The mass of coal remains as it is placed upon the grate, except as altered by the combustion. The returning grate bars pass into a water pan, 36, and the partition 39 extending down into the water prevents the blast from following the path of the grate bars around to the back of the furnace. The ash pit, which is practically the part to the left of plate 39, is closed by a door out of which the ashes are taken, and the front end of the boiler is closed by a sheet-iron casing passing down into the water.

The coal ignites and burns more from the bottom, the first thin layer of complete ash forming on the bottom and gradually becoming thicker. At first the ash is very hot, but the gentle current of air passing through it gradually cools it. The shaded portion in *C* and *D* shows the gradual formation of the ash, and the part to the left of that is the ash cooled or cooling.

Fire brick side walls showing a tendency to form clinker along them, we obviated that by making the sides of a hollow cast-iron bar, or water back. We now use a water back, made of wrought-iron pipe, formed to the proper shape. The feed water is fed into the front of this pipe and out at the back, and is heated to from 110 degrees to 150 degrees, which heat is all utilized. [We are compelled to omit here a description of the details of construction.]

As the speed of the grate is very slow—from 3 feet to 7 feet per hour—the sprocket wheels carrying the endless chains do not make more than one revolution per hour, often less, so that little power is required, but the revolutions of the driving shaft have to be much reduced by suitable mechanism. The two sets of worm gears have been replaced by the arrangement shown in Fig. 2, invented by Mr. F. H. Richards, of Hartford, Conn. The shaft *S*, which is 3⅞ inches diameter, is the one upon which the sprocket wheels to drive the grate are keyed. At *S′* it is reduced to 3¼ inches, and at *S‴* to 2¾ inches. The cone pulley shown at the right hand is keyed on a sleeve running on *S‴*, and at the end, *K′*, there is an eccentric made of the same piece with the sleeve, and upon the eccentric is a spur wheel, G_6, with 44 teeth. Upon the part *S″* of the shaft there is another eccentric sleeve carrying on the right-hand side an internal gear with 51 teeth. Upon the second eccentric there is another gear with 64 teeth, and keyed on the shaft *S* is another internal gear with 71 teeth. *D* is a portion of the pedestal which is fixed, and to it is bolted the cover *M*, also fixed. On the inside of this cover are two internal gears, one with 70 teeth and one with 50, which do not revolve, but mesh with one-half of the spur wheels. The revolving spur wheels mesh with both the fixed and the movable gears. As there is one more tooth in the first movable internal gear it falls back one tooth every time the cone pulley makes a revolution, so that 51 revolutions of the cone pulley make one revolution of the second eccentric *K*. When this second eccentric makes 71 revolutions the shaft *S* makes one revolution, so that it makes one revolution for 3,621 of the cone pulley. This reduction enables us to belt directly to the cone pulley from an ordinary line shaft. All the gearing is inclosed in the casing, which is partially filled with oil, so that the wheels run continuously in oil and are protected from the dust.

We have six stokers running under three Stirling boilers and four more being erected, two under two Babcock & Wilcox boilers

*A paper read by Eckley B. Coxe, of Drifton, Pa., before the New England Cotton Manufacturers' Association, at Providence, R. I., on April 24, 1895. Condensed by and for the AMERICAN MACHINIST.

and two under return tubular boilers to heat feed water for a large plant, and at works controlled by our companies we have stokers under Stirling boilers, tubular boilers and old fashioned cylindrical boilers, making 36 in all running or nearly ready.

The heat in the furnace is very intense, and we had much trouble at first about the arches under which the grate passed in entering and leaving the furnace, and also the arch over the furnace proper. This has been overcome by getting suitable fire brick, building our arch with care and thoroughly securing with buckstays. We have arches now with a span of 10 feet which are standing perfectly. In our newest construction we do not allow any part of the boilers to be subjected to the direct radiation of the fire. The advantage of this is that if you are burning bituminous coal you absolutely do away with the smoke, and in all cases you keep your ashes very hot until near the dumping point, and so the oxygen of the air will take up carbon in the ash while the latter is incandescent, and long after it would cease to do so if the ashes were cooled off as usual in the bottom of the furnace. In this way we can reduce the percentage of carbon in the ash to almost any point, although it will not pay to push this too far.

The stokers are all practically of the same length. The distance between centers of the sprocket wheels is about 12 feet 8 inches, and the part of the grate on which the coal burns is about 9 feet. The amount of coal burnt in cubic feet is the product of the width of available grate by the depth of the bed and by the speed of the grate. The amount of coal burnt per hour varies with the speed of the grate, pressure of blast, size of coal, and the depth of the bed of fuel. The maximum speed of the grate is limited by the rate at which the fuel will ignite, and the extent to which it is desirable to reduce the carbon in the ash. The larger the size of coal the thicker the bed can be, and the less the blast pressure for given thickness of bed. The usual depth for pea coal is 8 inches to 12 inches, for buckwheat 6 inches to 9 inches, for rice 5 inches to 7 inches, and for barley 4 inches to 6 inches. The width of the furnace is the measure of its capacity, rather than the number of square feet of grate.

What we think, or at least hope, can be accomplished by this machine is: The coal can be fed automatically, and is so fed in many of our plants, the fireman having nothing to do with handling the coal except to see that the machinery is kept in motion. There is no cleaning of fires. It is not necessary to open the fire doors for any purpose when the furnace is in operation. The boiler is kept always at the same temperature, and is not strained. We can and do use intelligent men as firemen, the work is comparatively pleasant, requiring no severe exertion but thought and attention. You need practically no more men for a thousand horsepower than for a hundred.

We can blow with dry air. It is not necessary to use a steam jet to prevent clinkering. While the furnace is running regularly it produces at all times the same results. No time is lost in cleaning fires, and no cold air is introduced when shoveling coal. Without difficulty we can obtain over 16 per cent. of carbonic acid and less than 3 per cent. of free oxygen without carbonic oxide, a result hardly possible with hand firing. We can certainly burn the finer coals with a less excess of air than we hoped for, or than is generally done. We have shown that the water evaporated per pound of coal does not depend practically upon the size, but upon the amount of combustible in the coal.

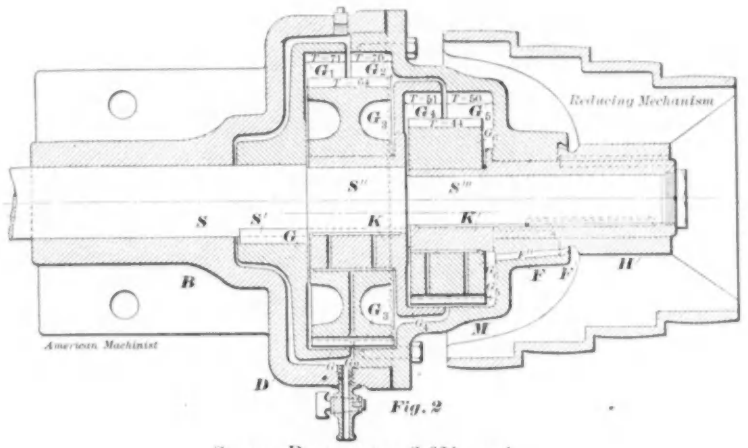


Fig. 2

SPEED REDUCTION 3,621 TO 1.

We have found that we could use a coal very high in ash without diminishing very materially the water evaporated per pound of combustible; but we have also found that the purer the coal and the larger its size the greater is the efficiency of the boiler. We have also found that we can burn bituminous coal without difficulty, and by properly regulating the air avoid absolutely the production of smoke. We think that by providing sufficient grate surface we can evaporate as much water, or nearly as much, with a ton of No. 3 buckwheat or rice coal as we can with pea coal, provided they are equally free from impurities, the only additional expense in the case of the small coal being the interest and depreciation on the additional plant necessary to produce a given amount of steam.

Is the Blacksmith's Trade-Mark a Scowl?

A writer on "Trades and Faces," in *Blackwood's Magazine*, finds the following to say about the blacksmith:

To disguise himself, the blacksmith has only, if possible, to put on a smile, and a frank and open expression.

As the smith wields his hammer with an energy that has something fierce and vengeful about it, he automatically contracts his brows into a frown. He does this partly, no doubt, to protect his eyes from the flying flakes of metal, but if you watch the face of the man who holds the iron on the anvil, you will find that, although he lowers his eyebrows somewhat, as the sledges descend, he does not scowl, as do the strikers. In most blacksmiths the constant exercise of the *corrugator supercilii* muscles causes a permanent frown, and gives the face a somewhat hard expression; but whether there is any inward and spiritual state corresponding with this outward and visible sign, I am not quite sure. . . . . I remember being a good deal impressed, when visiting in a shipbuilding town, by the intent gaze and bent brows of the riveters and boilersmiths with whom I was brought in contact. One instinctively wondered at first what there was about a harmless hospital surgeon, who ministered to them in times of dire trouble, to excite such an air of watchful hostility. I soon found, however, that no hostile sentiments were entertained, but that the frowning, falcon-like expression was explained partly by the "smith's scowl," above mentioned, and partly by the fact that all these men were rendered somewhat deaf by their noisy work, and, in consequence, had a habit of closely watching the face of anyone who conversed with them. Whether their characters in any way corresponded with their acquired expressions I did not discover; there was a grave courtesy in their demeanor while in hospital which was singularly dignified and pleasing, although always slightly suggestive of the politeness of foes during an armistice.

Gas for Power.

Some engineers interested in promoting the efficiency and economy of the steam engine have given attention to the boiler, with quite encouraging results. Now that the gas engine is coming into such general use, the composition of the gas used is found to be of great importance. The term candle-power is a misleading one, since a given gas may give the light without developing a proportional power. The gas acetylene, while of 240 candle-power, has a theoretical calorific capacity of 1,280 B. T. U. per cubic foot, or 5.33 units of heat per candle, while London 16 candle-power gas gives about 633 heat units per cubic foot, or 39.5 per candle. Whilst the former has about 15 times the lighting capacity it has only about double the heating power per cubic foot. The calorific value of New York gas is put at about 710 units per cubic foot. The incandescent system of gas illumination, now coming into general use, puts the lighting and heating abilities of the gas more nearly upon the same basis.

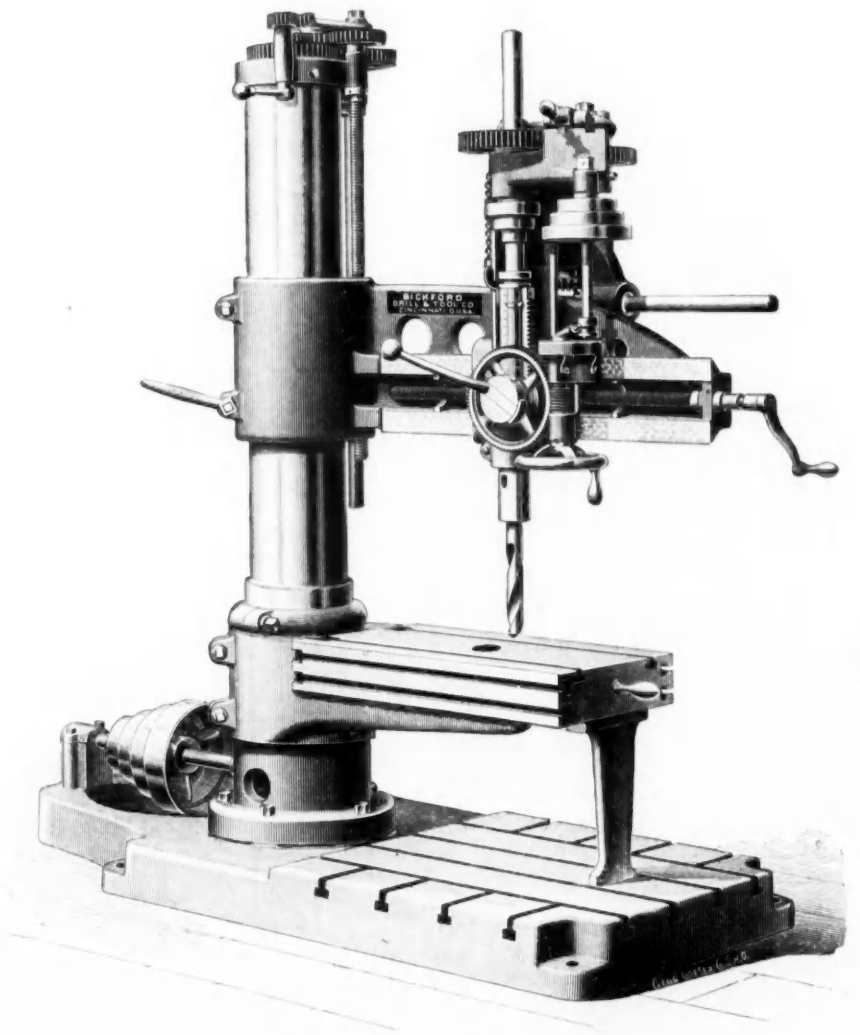
Tools of Annealed Mushet Steel.

Mr. B. E. D. Stafford, who is connected with B. M. Jones & Co., of Boston, called at this office a few days ago and showed us some tools made of annealed Mushet steel. Among these was a twist drill 1 inch diameter, grooved 6 inches in length. It was just as it left the milling machine and had been milled at a single cut for each groove in a universal milling machine in about one hour's time. The cut was taken dry, Mr. Stafford stating that so far as his experience had gone this was better than to use a lubricant. The cutter used was made of ordinary good tool steel. Another drill was shown that had been milled at the Brown & Sharpe shops and afterwards hardened by heating and cooling in air blast. This drill had seen severe service in drilling steel rails but was in good shape. A butt mill with taper shank and a twist drill cutter blank were also among the tools exhibited by Mr. Stafford, all these demonstrating that Mushet steel can be annealed and worked cold.

The process of annealing is to heat slowly (more slowly than usual) to a yellow heat and then cover with asbestos and allow to cool very slowly. B. M. Jones & Company have a furnace for heating, and when the desired heat has been reached simply open the furnace, cover the steel with asbestos, and allow the furnace to cool down with the steel in it.

A New Bickford Drill.

We illustrate the new No. 0 radial drill, built by the Bickford Drill and Tool Co., Cincinnati, Ohio. This machine possesses quite a number of points deserving notice. The base is heavy and amply slotted to receive the various classes of work. The stationary column or stump is bolted to the base, and extends about one-half way up the sleeve. The sleeve is fitted over this stump and carries the rotating arm. The bottom of the stump is enlarged to take the table. This table extends out to almost the end of the arm. It is supported at the extreme end by a special stand so as to make it secure in doing heavy duty. The table is locked by means of clamping bolts, and can, when it is necessary to use the base for the work, be swung to either side. The sleeve is tightened by means of a wedge-shaped ring which will lock it firmly to the stump. The head is fitted with the Bickford quick return, a new arrangement for throwing in the power feed, a new automatic stop, and a new arrangement of back gearing. The back gearing is placed directly on the head, thus taking all the strain from the long transmitting shafts and journals and giving the power direct to the spindle. The back gears can be engaged or disengaged while the machine is running, and the spindle can be stopped in this manner without reaching for the countershaft shifter. The machine is also made with a universal tilting table, which will allow the work to be placed at any angle, or with a round table fitted into either the plain or universal tilting table if desired. The machine weighs 3,000 pounds.



IMPROVED RADIAL DRILL.

Death of A. M. Wellington.

A. M. Wellington, C. E., of the *Engineering News*, died in this city on May 16th, in his 48th year. Mr. Wellington was engaged in engineering work, principally upon railways, for more than 20 years. He held,

among other positions, that of chief engineer of the Interoceanic Railway from Vera Cruz to the City of Mexico and the Pacific Coast, and was assistant general manager of the Mexican Central Railway. He became one of the editors and proprietors of the *Engineering News* in 1887. He was the author of several valuable works upon engineering subjects. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Canadian Society of Civil Engineers, the British Institute of Civil Engineers, and the Engineers' Club, of this city.

In 1892 Mr. Wellington became interested in thermodynamics and invented a new system of transforming heat into mechanical work, designed to effect this transformation with less loss than in the best steam engines. In developing this invention he labored so incessantly that his health failed. We understand that the invention was practically completed.

LETTERS FROM PRACTICAL MEN.

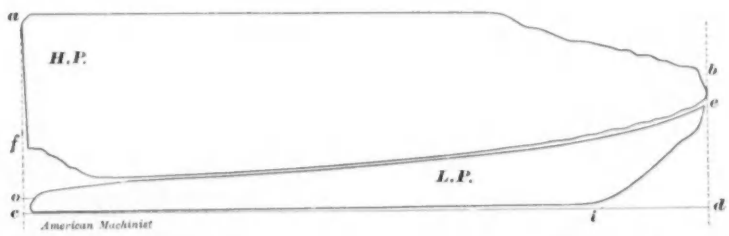
Single-Cylinder Compound Engine.

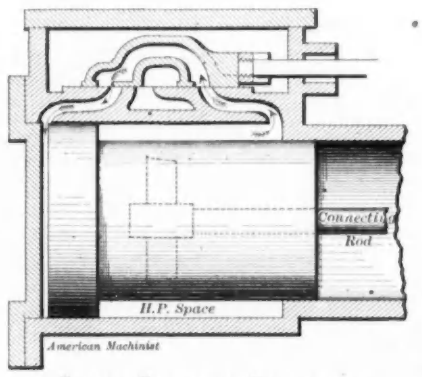
Editor American Machinist:

I inclose an indicator card taken from what may be termed a hybrid compound engine. High-pressure steam is admitted only on one side of the piston, and is then exhausted to the other side for the return stroke. The high-pressure side is formed by an annular space between the piston trunk and the cylinder; the low-pressure side has the whole effective area of the piston. The relative areas, as you will see noted on the card, are 40 square inches and 160 square inches, or four to one. There is some difference of opinion as to the proper method of figuring the power of this card, so I thought I would write and find out how you would calculate it. This card shows a remarkable admission line for a plain slide valve, and is not due to the slow piston speed, for it shows the same absence of wire drawing when running at 300 and 400 feet, but is due, I think, to the abnormally large port area for the high-pressure side, being equal to 8.625 square inches for a cylinder area of 40 square inches. I have been trying to eliminate the sharp corner from the compression curve by cutting down the clearance, but have not succeeded entirely, although there is a decided improvement in that respect over former cards. What I should like to accomplish would be to eliminate the drop from the terminal on the high-pressure to the initial on the low-pressure, due presumably to clearance, and I know of no better way than by compression, although for some reason or another—probably from a leakage in the valve—I have not been able to accomplish it. I also inclose a sketch of the cylinder. F. Thornely.

[The sketch and description furnished by our correspondent of the single-acting vertical compound trunk engine, if that is a proper name for it, will doubtless be of interest to many of our readers, and, in connection with the admirable indicator cards furnished, will suggest several points worthy of investigation and discussion. The purpose for which the compounding of the steam engine is adapted would seem to be defeated by the use of the same cylinder, or a considerable portion of it, for both the high and the low-pressure. The friction loss in this engine must range high, but so compact and simple a whole could scarcely be secured without some sacrifice.

This matter seems to be brought to our notice especially upon the question of computing the power indicated by the cards. If the actually inclosed area of each card be taken and computed for its own piston travel and area, the sum of the two results will represent the total indicated horse-power, but it will not represent the actual distribution of the power through the connecting rod for the different portions of the revolution of the crank shaft. We make the M. E. P. of the high-pressure card 42.9 and of the low-pressure card 12.3, and the I. H. P., respectively, at 125 feet piston speed for each, 6.5 and 7.45, or a total of 13.95. Here the I. H. P. of the high-pressure stroke seems to be about 14 per cent. less than for the low-pressure stroke, but it is evident that we have not given the high-pressure side all that belongs to it. The pressure in the high-pressure cylinder at any point of its working stroke should be measured from the line *a b* to the atmosphere line *c d*, and not to the back pressure line *e f*, which belongs to the return stroke, and has no more to do with the working stroke represented by the line *a b* than if it never existed. This adds to the card area previously computed all of the area *c d e f*, and the only deduction to be made from this is the back pressure of the low-pressure side of the piston, most of which is concentrated at the compression corner *e i d*. We make the M. E. P. for the complete high-pressure card *a b d e* to be 59.52, and the I. H. P. 9.018. Then if the back pressure *c i d e* is 2.5 pounds, the I. H. P. is 1.515, and deducting this we have 7.503 as the net I. H. P. of the high-pressure stroke. For the low-pressure stroke we find the M. E. P. of *e o c i* to be 15, and the I. H. P. 9.09, then the back pressure *e f c d* being 17 and the I. H. P. being 2.57, this being deducted leaves the net I. H. P. of the low-pressure working stroke 6.52. The total, then, for both strokes is 7.503 + 6.52 = 14.023 or very little different from 13.95, the total I. H. P. obtained in the first case. In the last result, which we take to more correctly represent the true state of affairs, the 14 per cent. of difference in the work of the alternate strokes has skipped over to the other side, and the work for low-pressure





Single-Cylinder Compound.

working stroke is the least of the alternate portions. In the figures used above, the M. E. P. of the cards has not been carefully measured, but more minute accuracy would not affect the complexion of the result.—Ed.]

About Crosshead Gibs—Speed of Shafting.

Editor American Machinist:

During 1893, the writer met with a German engineer who mentioned the fact of his concern giving up adjustable gibs on crossheads for engines under 50 horse-power. This is against current American practice, but the wear of crosshead gibs seems an unknown quantity. They do get taken up once in a while, but how often no one seems to know.

In talking with one man on the subject, he gave a little bit of personal experience which seems worth while noting. He has charge of a pair of Brown engines, 24x48, running under, at 58½ revolutions per minute, horse-power about 260, boiler pressure 80. For three years of the time they have been in use they were running 22½ hours per day. They were set up about 1881. The guides were V-shape and the gibs were babbitted. As he had some trouble with them, he put in strips of lignum vitæ for gibs which ran for about eight years, and three weeks ago he put in a new set. The wood swells a little after the oil soaks into it, and the gibs must be set back a little. After that they run four or five months without any attention save oiling.

He has also two fan engines under his care, 8¼x8¼ double horizontal, which run from 250 to 400 revolutions per minute, from 5 A. M. to 6 P. M. during the winter months. The crosshead guides were flat and the gibs lined with babbitt. Each fall he had to rebabbitt them. Three years ago he planed them flat, substituting lignum vitæ for the babbitt and fastening it to the gibs by countersunk screws. They seem now as good as when first put in.

A certain concern has a machine in operation which requires that a 6-inch sleeve or quill be driven 1,150 revolutions per minute under a heavy load. The bearings heat and the machine must be stopped every two hours to allow them to cool. This speed corresponds to a rubbing velocity of 1,807 feet per minute, and is much faster than the ordinary speeds of shafting. Can any of your readers give instances of shafts which are running successfully at such high speeds?

Wm. Sangster.

English vs. American Lathes.

Editor American Machinist:

As pertinent to the discussion on "English *vs.* American Lathes," and also as introductory to something I want to say on that subject, I will ask you to reprint the following brief article, which was read by me at the first meeting of the American Society of Mechanical Engineers, in November, 1880, on "Strength in Machine Tools." The introductory paragraphs are omitted.

"Truth of construction, facility of operation, and range of application, are all, in one sense, subordinate to this fundamental quality of strength; for these are in a greater or lesser degree impaired where adequate strength is not provided.

"But what *is* adequate strength? On this point there exists among makers and users of tools a wide diversity of opinion. On examination it will be found that this diversity coincides with the diversity in mechanical sensibility. As the mechanical sense is developed, in just the same degree there arises a demand for greater strength in machine tools. To the mechanic who has never formed a notion of a division of an inch more exact than "a bare thirty-second," one lathe, if it can in any way be kept from chattering, is as good as another, and better if it is cheaper. To those, on the other hand, who demand in every piece, as it comes from the tool, the closest approach to perfection, both in form and finish, a degree of strength in the tool appears, and is demonstrated, to be indispensable, that to the former class seems as absurd, as the results obtained by means of it appear incredible.

"In this country, as indeed all over the world, the general standard of mechanical truth has been very low. It is here, however, as everywhere, rapidly rising. The multitude are being educated up to the standard of the few. In this work members of this society have borne, and now bear, an honorable part. Just in the degree that the standard of mechanical excellence is raised must the demand become more general for greater strength in machine tools, as indispensable to its attainment. But what is the standard of strength? The anvil affords perhaps its best illustration. This represents a strength enormously beyond that which will prevent a lathe from chattering, a strength which under the heaviest labor prevents any indication of effort, more than if the object being cut were a mass of butter.

"It will be seen, that this absolute solidity, while truth cannot be attained without it, also enables mechanical operations to be performed with far greater expedition, and the subsequent work of the finisher to be much diminished, and often dispensed with entirely. We are enabled to come at once to the form desired, whatever may be the quantity of material to be removed, and to finish the surface with a degree of truth and polish otherwise unattainable, dispensing with the use of that abomination—the file.

"Now with this standard in our minds, we look over the face of the land, and behold it covered with rubbish. It is curious to observe how ingenious tool makers have been in trying to avoid this quality of strength, and what a deceptive appearance in this respect many tools present. It is interesting to note how little this quality of strength adds to the cost of castings. The addition is merely so much more pig-iron, and really not that, because in the stove-plate style the forms are more complicated, the patterns more expensive and frail, and the cost of molding is greater. But what signifies even a considerable increase in the first cost of a tool that in daily use is to perform the work of many?

"It is not the purpose of this paper to enter into details, but to draw attention to the subject in a general way. The improvement observed quite recently in the respect of strength, as well as in other points of tool construction, is highly gratifying, and encourages the expectation of still further and more general progress."

Every one knows in what a large degree this expectation has been met, in the interval of more than 14 years that has elapsed since the above paper was read.

The lathe of the future will, I think, combine the best features of the English and the American types. These are all there are. The Continental mechanics are copyists merely. It can hardly be made too heavy, especially in the bed. The English lathe is free from one abominable feature, without which, I have been told, a lathe cannot be sold in this country, that is, the adjustable tail stock. The ingenuity of the Yankee often outruns his judgment. This adjustable tail stock is an example in point. It is demanded to enable the lathe to turn taper. It is set over for this purpose, and the center and the arbor are ruined. Maybe the workman sets it back truly central, but probably he does *not*. The chances of his doing so are about one in a hundred. Some of the most serious disasters I have ever known, have resulted from a tail center being out of line, and nobody knew it. With the admirable taper attachments now in use, all excuse for this absurd feature is taken away.

Another feature which we may advantageously copy from the English is solid, conical bearings for the lathe spindle. These, if large enough and long enough, and provided with adjustments by which wear can be taken up, and truth of alignment preserved, are for all, except the largest class of lathes, far preferable to the boxes in general use in this country.

Chas. T. Porter.

The Smallest and the Largest Round Punch and Die.

Editor American Machinist:

I send you a sketch of what I think is the smallest and the largest round die in use, and should any of your readers know to the contrary, I would be pleased to hear from them.

There are dies containing more cutting surface, but in actual diameter I think the large one will exceed them; it is a compound die, used for the sheet-iron disks in the armature for a large electric railway generator for street-car service.

Diameter of outside die, 45″.
Diameter of inside die, 25½″.
Weight of punch, 1,200 lbs.
Weight of die, 1,100 lbs.
Cutting surface, 210″.

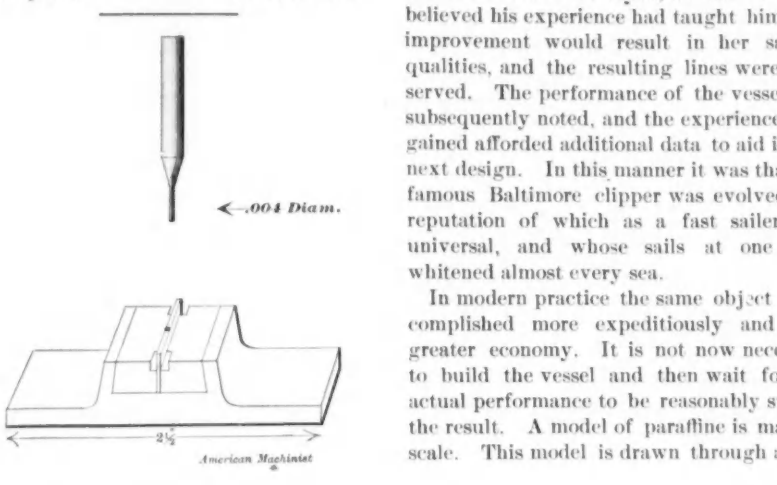
The small die at the top of sketch is used for the eyes of sewing machine needles at the factory of Whitten & Lascelle, Lynn, Mass.

Diameter of punch, .004".
Length of punch, $\frac{1}{16}$".
Thickness of stock punched, .008".

The die is made sectional in three pieces, the center one projecting up above the surface of the sides of the die and into the groove of the needle, thus supporting the part being punched.

It is used in a special press so arranged that the work is first clamped and then punched, the speed of the punch being very slow. The punches are made of .080 inch Stubs' wire milled down to about .030 inch diameter, then hardened and finished by being ground to shape in a special grinder.

The large die is used in an E. W. Bliss No. 96 press. J. L. LUCAS.



THE SMALLEST AND THE LARGEST PUNCH DIE.

Determining the Lines of Vessels—Marine Propulsion.

Editor American Machinist:

Your editorial remarks on "Fast Steam Launches," in issue of May 2d, are, in the main, correct, but permit me to say in this connection that I do not see why you have made reference only to the resistance to be overcome, without allusion to driving force—the propelling apparatus. Undoubtedly there is as much credit due to improvements in the latter branch of scientific development as to improvements in the hull in reducing its resistance.

The old wave-line theory of Scott Russell, as well as that of the augmented surface of Professor Rankine, answered well in their day. The memorable computation of the latter on this basis of the speed of the "Warrior," is entitled to additional credit from the fact of his having so little of the data accessible to modern naval architects to aid in his deductions. Much of the knowledge that we at present possess regarding the resistance of bodies passing through water has been acquired in practice, even as it was in bygone days, but with the aid of modern appliances and accumulated experience. Dr. Froude, supported by the British Admiralty, has done more than any other to enlarge our knowledge of the resistance to ships. In the absence of his tank experiments on models, and his remarkable acumen, we should probably be yet far from attaining the present high speed of vessels.

Your reference to the stream-line theory might lead some to infer that it was inapplicable when speeds exceeding ten knots are encountered. Whether this be true or not will depend altogether on the form of vessel and the condition of the surface. One would not expect to drive with equal power a submerged cube as fast as a circular spindle, although their surfaces might be equal in extent and condition. When speed becomes sufficient to cause a body moving through water to break up the natural lines, to force them out of their natural path, and cause them to degenerate into eddies, then all is problematical, and experimental research is necessary to determine the resistance.

When a boy, it was a great delight to me to stroll through the shipyards, which at that time could be seen in every direction around the harbor of Baltimore, where vessels of every type, and in all stages of construction, could at all times be seen. And it induces a somewhat mournful reflection when I think of the decadence of that great industry. The reputation of the Baltimore shipbuilders was world-wide, and yet it is believed that there were none among them who could be regarded as scientific marine architects in the light of the present state of the art of ship designing. Nevertheless, they were successful. Their method was to lay down the lines from which a model was constructed; this model was then eased off here and there, as the designer believed his experience had taught him that improvement would result in her sailing qualities, and the resulting lines were preserved. The performance of the vessel was subsequently noted, and the experience thus gained afforded additional data to aid in the next design. In this manner it was that the famous Baltimore clipper was evolved, the reputation of which as a fast sailer was universal, and whose sails at one time whitened almost every sea.

In modern practice the same object is accomplished more expeditiously and with greater economy. It is not now necessary to build the vessel and then wait for her actual performance to be reasonably sure of the result. A model of paraffine is made to scale. This model is drawn through a long tank by suitable apparatus; the resistance to the hull, as well as the energy expended in overcoming this resistance, is recorded. These data, applied according to a law established by Dr. Froude, will result in a close approximation to the resistance of the full-sized vessel, when the condition of the surfaces are similar.

But my intention was to write on improvements in the propelling department of fast vessels, on which subject I presume to have better information than on that of the reduction of the resistance of hulls. The increase of steam pressures in marine practice has permitted higher piston speeds and lighter engines. In this direction, with the growing use of sectional boilers in marine practice, continued advancement may be expected, until about 300 pounds per square inch is attained, when the accompanying temperature will be a bar to further progress, with the materials at present employed. Greater piston speeds permit a higher number of revolutions, and this in turn allows a reduction in the size of propellers, and, consequently, a greater immersion of them—a most important feature in regard to the efficiency of propellers. In former days it was thought advantageous to use propellers as large as possible, but modern practice has proved the fallacy of this.

In designing fast vessels, regard must be had to a favorable position of the screws for obtaining a full and free supply of water, and also for the free discharge of the water as it leaves the propellers. If the discharge is obstructed the water will be carried around with the revolving screws to the extent of the obstruction, and to the detriment of the propulsive effect. By the use of small screws with smooth surfaces, their frictional resistance, which is greater than their form resistance, is reduced. The condition of the water has much to do with efficiency. The most favorable condition is still water, but this condition never prevails with an advancing vessel; there is always a body of water, to a greater or less extent, carried along with an advancing vessel, resulting from the frictional resistance of the water on the surface of the hull. When a screw works in such water its first effect is to bring that portion with which it comes in contact to a state of rest; in so doing, some of the energy expended by the vessel will be recovered. From the condition of still water the further action of the propeller on it will impart motion, and discharge it in an opposite direction to that in which the vessel is moving.

The fundamental principle of the action of every marine propeller is the same, whether it be a screw, paddle, turbine, or other instrument. The propeller drives backward a certain quantity of water at a certain speed. In so doing, it presses backward against the propeller with an equal force; this force is transmitted to the framework of the machinery, and thence to the vessel, which is thereby driven forward. The advantage that a screw propeller possesses over other kinds is that it receives a greater benefit from the inertia of the water it acts upon, that is, from the resistance the water offers to being put in motion from a state of rest, and this advantage will increase with the depth of immersion.

I. MCKIM CHASE.

Washington, D. C.

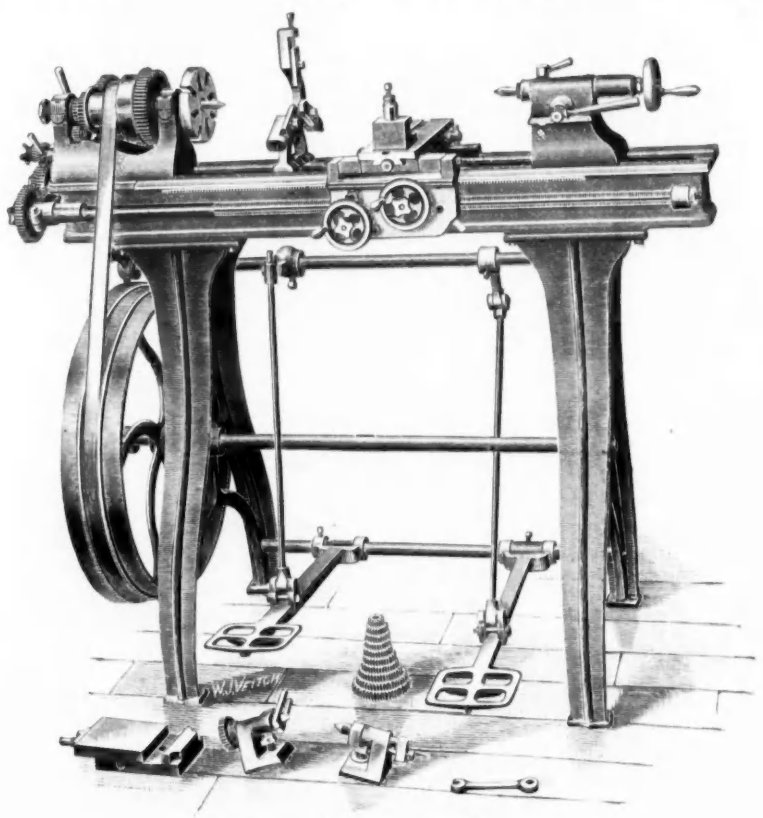
The Second Breakdown of "La Gascogne."

The steamer "Gascogne," of the French transatlantic line, reached her pier on May 22d, about four days overdue, having been delayed by an accident apparently identical with that which delayed her so long, and caused so much anxiety for her safety in February of this year. In the former accident the piston of the second intermediate cylinder broke right in two upon the third day of the voyage, and in very rough weather. In this second accident the piston of the same cylinder broke upon the fifth day of the trip, and with excellent weather. The same expedient of connecting the cylinders without using the disabled one was adopted with more or less trouble from the inequitable distribution of pressures, but with the happy result of reaching port in safety. The piston broken in February was replaced by the Morgan Iron Works, of this city, with a piston which they had held ready for an emergency for several years, and which weighed four or five tons. The piston worked all right, but upon the return of the steamer to France, a piston 1,000 or 1,500 pounds heavier was put in, and the American piston was brought back, and, as we write, it is the intention to put this piston in again. The dimensions of the piston, it will be remembered from the sketch which we published upon the former occasion, February 21st, were 6 feet $7\frac{1}{16}$ inches diameter, and 10 inches thick. The form of the piston, perfectly flat, is now generally avoided as being the worst possible. When we visited the steamer, the piston had not been got out, and we were unable to see it. The engine consists of six cylinders, arranged in three tandems, and the broken piston was in the lower cylinder of the middle tandem, so that to get it out it was necessary to hoist off the upper cylinder, and this operation was in progress at the time of our visit.

The engine of "La Gascogne" was originally triple expansion, but was changed to quadruple expansion, and new boilers were put in, raising the boiler pressure from 160 to 225. There are but two different diameters of cylinders, the upper ones being $42\frac{1}{2}$ inches, and the lower ones being $79\frac{13}{16}$ inches. One of the upper cylinders is high pressure, and the other two are the first intermediates. The middle cylinder below, whose piston broke, is the second intermediate, and the other two lower cylinders are low pressure.

A Lathe Adapted for Milling.

We illustrate a lathe 10 inches by 4 feet, made by Wallace H. Mansfield, New Haven, Conn., and possessing some new and important features. The swing over the bed is 10 inches and over the carriage $6\frac{1}{2}$ inches, and 27 inches between centers. The bed is stiff and heavy with four Vs; the lathe is back-geared, and the cone has three steps for $1\frac{1}{4}$-inch belt. The spindle is $1\frac{1}{4}$ inches, with a $\frac{1}{2}$ inch hole, and runs in adjustable bronze bearings. The tail stock has the side adjustment for tapers, and a quick-acting positive locking device. The carriage is gibbed to the bed, and both longitudinal and cross feeds are operated by a splined sleeve upon the feed screw, so that the thread of the screw is only used for screw cutting. The carriage is made with tool holder for lathe work only, or with a "universal" mill carriage, consisting of a sliding table fed automatically and elevated by screw, the table carrying a tool block for turning, fixtures for boring with a bar, vise, index centers, gear-cutting attachment, etc., making it very handy for general milling. The table is 4 inches by 12 inches, has $2\frac{1}{2}$ inches vertical adjustment and 7 inches feed. The vise has $3\frac{1}{2}$ inches jaws, opening 2 inches, and swivels to any angle. The index centers swing 2 inches, and the dial is drilled with 7, 8, 11, 20 and 36 holes. The milling arbors to hold cutters have taper shank fitted to spindle, and with bushings will fit holes of $\frac{1}{2}$ inch, $\frac{3}{8}$ inch, $\frac{3}{4}$ inch, $\frac{7}{8}$ inch and 1 inch. The lathe is furnished with either countershaft or foot motion. The treader may either sit or stand. The lathe should be of value to the amateur or in the small jobbing, model, or repair shop.



A LATHE ADAPTED FOR MILLING.

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NEW YORK, MAY 30, 1895.

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"Hoisting" the Shafting Down.

While we hold to the belief that the engine lathe is the supreme tool of the machinist, and that it can never be superseded, we must still acknowledge that its proportional numerical representation in our shops has undoubtedly diminished. The number of lathes in use has diminished as compared with other individual tools—and we go back now to the time when, practically, all the tools of the fully equipped machine shop were the lathe, the planer and the upright drill—and especially and largely has the lathe decreased in numbers as compared with the total number of tools in the average shop. The gradual decrease in the number of engine lathes has come about in two ways. Other tools are now doing very much of the work that was once done by the engine lathe. The turret lathe, the milling machine, the screw machine, the boring machine, the bolt cutter, the various grinding machines, all do work that once belonged to the lathe. But a greater cause for the change is to be found in the character of the work to be done. The machine shop has ceased to be a builder of machines exclusively. Ship building, bridge building and structural work now require a vast amount of machinery, and practically no lathe work at all. There are iron and steel working establishments among the largest in existence that have no use for the engine lathe, except for the making and maintenance of tools. In the olden time every other machinist called himself a latheman, and it was practically necessary for every machinist to be more or less familiar with and expert at the lathe. To-day it would be difficult to characterize a machinist by another and more specific title than machinist that he would not regard as too narrow, and, if he happened to be looking for a job, as limiting his chances of getting it. The only particular applicable to the universal machinist of to-day is that he is a maker of chips. The cutting or abrading of metal is almost his sole occupation. And here a curious thing comes up. While the making of chips is his business, his efficiency is not to be measured by the amount of chips that he makes. Some have tried, and are still trying, to put the engine lathe upon this basis. The lathe builders are always talking about coarse feeds, wide belts, strong gearing, and general efficiency in the making of chips, and transatlantic practice in the lavish use of metal in tools to this one great end is continually harped upon, while at the same time the material from the forge and the foundry is continually coming to the lathe more nearly to the size and shape required, and with a continually reducing possibility for the profuse production of chips. The machines that are coming to the front, and upon which the bulk of the product of the shops is now dependent, are not pre-eminently chip producers, and generally not comparable with the engine lathe for their ability in this respect.

If any machine tool has held its own in the struggle for existence, and may claim to successfully exemplify the survival of the fittest, it is the upright drill. Upon the question of relative numbers we can only hazard a wild guess, but we are of the opinion that as compared with, say, a quarter of a century ago the percentage of drills to lathes in use has more than doubled. We hope that we are in touch with the activities of the shop, and feel by instinct and sympathy its tendency and direction, and we hope to keep pace with its rate of progression. In the last five years we have described and illustrated more drills than in the previous decade, and we probably have not at that given the drills any more than their just and equitable share of attention.

As a maker of chips the drill cannot be compared with the lathe. It is not to be expected, because the conditions under which the material is removed by the lip of the drill, say, a twist drill, are very different and far less favorable than the cutting conditions of a lathe tool. But the drill still has its right to be, and its numbers increase, because it does what happens to be wanted and as it is wanted. The upright drill has been improved vastly more than the lathe in the last few years, and the improvements have been in the direction of making it more ready and convenient for the work that is wanted of it. The tendency toward improvement in the drill is probably as great to-day as ever, and it is not necessary to particularize as to the direction toward which the improvements are looking, because they continue in the same line as that in which they have been going of late years—that of general adaptability, and especially of accessibility. The great thing aimed at is to make it as easy as possible for the drill to get at the work and for the work to get at the drill. Nobody thinks much about getting chips faster out of the individual hole, and there is not much hope for anybody in that direction until someone finds a radical improvement in the twist drill. The various forms and combinations of the radial drill enable it to get almost anywhere about a piece of work, and to operate well and rapidly under all the various conditions. The movement toward the use of independent motors for the drill is mostly to be commended and encouraged, because by removing overhead belting and shafting, and all outside connections, it makes it easier to approach the drill from all directions, by the soon to be universally employed traveling hoist. Better than the individual motor for the drill, is the system of driving it from below the floor. The radial drill is especially adapted to the application of this system, and no tool can better display the advantages of it. A central spindle may come up from below the floor through the main column of the drill, and supply all the power, and leave the drill absolutely free and accessible from all sides. Such drills and this system of driving are advertised in our British exchanges, and the AMERICAN MACHINIST should certainly contain an advertisement of that character. Driving from below, where it is tried, will be adopted, and where it is adopted it will probably work the same as the air-hoist works. Whoever has it wants more of it; and there is no advertisement so strong and effective as knowledge of and familiarity with the thing itself. With the drills driven from below it would soon come to driving planers, shapers, bolt cutters and other machines in the same way, and it should not be long before bridge shops and architectural iron works, that have to handle a great quantity of heavy material, with a little machine work imperatively demanded for each piece, would be entirely without overhead shafting, and would have every inch of the floor space commanded by the traveling hoists.

The Balance of Occupations for the Sexes.

A recent notice of the life of Sir Henry Bessemer, now 83 years old, in speaking of his other inventions besides that supreme invention of the converting process, which made his fame, and brought him wealth and honor, the wealth and honor coming last of all, and most grudgingly of all from the British Government, goes on to say: "It is characteristic of the man that he should take a particular pleasure in his invention of a machine for the manufacture of nails, for the simple reason that this invention relieves hundreds of young girls in what is known in England as 'The Black Country,' and Wolverhampton, of the degrading toil of forging nails by hand. In filthy, reeking dens these poor young things passed their lives in 'unwomanly rags,' engaged in unwomanly toil. But Bessemer has altered all that."

This seems to give us something to think about. We must agree that forging nails is not a proper occupation for girls, and to make it impossible for them is, so far, a good thing; but the question remains as to how much they were "relieved" and to what extent the invention of the nail machine "altered" all this for the better.

We are not here opening the question, long ago settled for us, of the ultimate beneficence of superseding hand labor by machinery. There naturally is work enough for all, and what we want to suggest is that something more might be done toward securing a balance of occupations for the two sexes in a community. Machinery has given employment to people rather than robbed them of it, and it has made work for women, and suitable for women, quite as liberally as it has made work for men. This is true as pertaining to mechanical occupations in the United States, but it is probably true of England that the development of occupations for females has not kept pace with the growth of male occupations. The "Black Country" has become a region for male workers principally, and sufficient work for the females has not been provided, and this has reacted to the damage of the male occupations, as in the case of the girl nail makers.

This matter has generally arranged itself—for there has been no intelligent direction of it—better in the United States. We have especially in mind the city of Troy, N. Y., which is known all over the world as the seat of the collar and cuff industry. When this business arose Troy was much smaller than it is now, but it was the largest producer of stoves in the United States, the Burden Nail Works were in full blast (they never employed a female worker) and the largest steam engine works and general machine shop north of New York City was also there. It was a city of male workers, and of unemployed females, and in providing occupation for the females the collar and cuff industry arose, and business enterprise has developed it to enormous proportions, and within a generation the balance of occupations for the two sexes in the community has been reversed. Several cities now make more stoves than Troy; it cannot compete with Pittsburgh in the production of iron and steel, the engine works and machine shop mentioned have died of the diseases that have so often proved fatal, and this city would seem to be a very proper place for new manufacturing enterprises giving occupation exclusively or principally to men. The valve business has three or four flourishing establishments of recent growth there.

We have an impression, at this writing, that Pittsburgh, Cleveland, and some other manufacturing cities, are suitable places for establishing more of the female industries, while the balance in New York City would be promoted by a reversal of the process. This matter would seem to be worthy of more attention than we have given it here, and we may be able to refer to it again.

Ambidextrous Reasoning.

In a recent issue of *Engineering* we find the following, occurring in a notice of the work of the late Frederick E. Sickels:

"To a certain extent, no doubt, the invention of the trip cut-off gear kept back the progress of steam engine design in the States, as it delayed the development there of the compound system of working. So that for many years American engines, though admirable as pieces of mechanism, were inferior as steam engines to the less ingenious but more economical compound engines used on this side of the water."

All this is perfectly indisputable, and may possibly be true; but it would have been equally indisputable and quite as possibly true if it had been said, instead, that Sickels and Corliss and the trip cut-off were among the chief promoters of the development of the compound engine in the United States, and that they hastened rather than delayed its coming. If Sickels began in 1841 to delay the development of the compound engine in America, it would be interesting to know what delayed its development in England from the days of Hornblower, 1781, and Woolf, 1804. We know that from the beginning and all along the steam engine was developed in this country upon lines entirely different from those followed in Great Britain. The non-condensing engine was as universally used in America as the condensing engine was in England. The conditions of business in America did not enforce the mi-

nute economies. So that the engine would run and give power enough the mill owner was satisfied, and when Corliss began to introduce his engine he was not undertaking to fill any "long-felt want." The want was of later growth. The Corliss engine did not find a market, but made a market. Corliss made a greater transformation in the engine buyer than in the steam engine. The enormous savings demonstrated by the installation of each successive Corliss power plant soon opened the eyes of the mill owners, and they have remained open ever since. Corliss at the same time opened the eyes of many a mechanical investigator and inventor. His financial success showed to all a promise of reward ever after open to the promoter of steam-engine economy. In the making of the new conditions, in awakening the mill proprietor to a more exacting economy, and in showing to every inventor the new mine to work, how could he better have promoted the development of the compound engine or of anything else that gave any promise of still further savings?

According to the authority quoted above, the actual effect of the trip cut-off seems to have been a most peculiar one. It delayed the development of the compound engine in the United States, and yet furnished in itself one of the most important elements of the completed or up-to-date machine. "Nevertheless, a combination of the trip valve gear, with the compound or tri-compound system of working, has given us the most economical modern engines, and the invention of the former item must be attributed to Sickels."

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(221) F. W. R., St. Louis, Mo., writes: Please give the name of a book treating on the designing of gear teeth. *A.*—"Practical Treatise on Gearing," published by Brown & Sharpe Manufacturing Company, Providence, R. I., and the "Handbook of the Teeth of Gears," by George B. Grant, Lexington, Mass., are good books.

(222) A. G., Philadelphia, Pa., writes: Please give name of a book treating on screw cutting, also give name of publishers. *A.*—"Screws and Screw-making, with a chapter on Milling Machines," by the Britannia Company, Colchester, England, sold by Spon & Chamberlain, 12 Cortlandt street, New York, may suit you.

(223) S. C., ——, asks: Is there any way to stiffen springs of German silver drawing instruments? *A.*—We suppose the springs you refer to are of steel, and it may be possible to increase the tension upon them by removing them from the instrument, and bending them in such a way as to make them exert more pressure. This will not stiffen them, strictly speaking, however, and the only way to stiffen such springs usually is to throw them away and put in springs that are stiffer. 2. What do writers on social science mean by the "living wage?" *A.*—They mean the amount of wages which, under the conditions, will just barely enable laborers to live and rear families, so that the supply of laborers will not be materially reduced. 3. What is a direct-acting engine, and what is its opposite? *A.*—Nearly all the common engines seen are direct-acting. A beam engine is not a direct-acting engine. 4. What are inverted cylinders, as the term is applied to marine engines? *A.*—Inverted cylinders are cylinders which are placed above the crosshead, and which have the piston rod and stuffing box below them. Nearly all marine engines used for turning screw propellers have inverted cylinders.

(224) N. J. A., Trenton, N. J., writes: Kindly advise us in regard to the following: What is the least weight of fly wheel we can use for a horizontal engine 5x8 inches, running at 250 revolutions per minute, so as to get sufficiently steady motion and the engine to stand still when mounted on a four-wheeled truck? The size of the fly wheel that we are now using is 36 inches diameter and 6½ inches wide. The reason for the desire of having the least weight in the wheel is to reduce the power required for carting the engine over the road. *A.*—For comparatively steady running use the same diameter and width of wheel as at present in use, and make the thickness of the rim so that its weight will not exceed 300 pounds. The arms and hub should, of course, be proportioned correctly for the diameter of wheel, and not be made heavier than necessary for the work they have to do. For obtaining steadiness in running when the engine is mounted on the truck, means must be provided for balancing the weight of crank, crank pin and one-half the weight of the connecting rod. Probably the best way to accomplish this is to use a disk with crank pin on one side of the shaft and the counterbalance weight placed opposite the crank pin. It can hardly be expected that the engine mounted on a truck will stand perfectly still when at work even under favorable circumstances.

(225) D. S., St. Joseph, Mo., writes: I want to find the number of gallons of water discharged per minute through a pipe 3 inches inside diameter under a pressure of 100 pounds per square inch. Please give me a rule for computing the discharge. *A.*—The first step will be to find the head in feet due to the given pressure by the following rule: Multiply the pressure per square inch by 2.304; the result will be the head in feet. According to this rule, the head will be

$$100 \times 2.304 = 23.04 \text{ feet},$$

say, 23 feet. The next step will be to find the velocity of the water in feet per second by the following formula:

$$v = \sqrt{\frac{64.4 \times h}{1.5 + f\frac{l}{d}}}; \qquad (1)$$

in which v = velocity in feet per second, h = head in feet, l = length of pipe in feet, d = inside diameter of the pipe in feet, and f = a friction factor which varies with the roughness of the interior surface of the pipe, the diameter of the pipe, and the velocity of flow. A rough mean value for f, often used in approximate computations, is .02. Adopting this value, the above formula reads: Multiply the head in feet by 64.4; call this product A. Divide the length of the pipe in feet by its diameter in feet, and multiply this quotient by .02 and add 1.5 to this product; call this the sum B. Now, divide the product A by the sum B, and find the square root of this quotient; the result will be the velocity in feet per second. To show the application of this rule, we shall assume that the length of pipe is 36 feet; substituting for the letters in formula (1) the corresponding values, we have:

$$v = \sqrt{\frac{64.4 \times 23}{1.5 + .02 \times \frac{36}{.25}}} = 18 \text{ feet}.$$

To find the discharge per second, multiply the velocity as found above by the area in square feet of the pipe; the result will be the discharge in cubic feet per second. This gives us $18 \times .049 = .882$ cubic foot discharged per second, or $.882 \times 60 = 52.92$ cubic feet per minute. To compute the number of gallons, multiply 52.92 by 7.481 = 395.89, which is the number of gallons discharged per minute.

(226) J. L. K., Old Town, Me., writes: We are thinking of carrying steam through a distance of about 1,200 feet to run a 40 horse-power engine, and planned to carry the pipe about 3 feet underground, the pipe is to be wrapped with asbestos, and inclosed in a box which is to be surrounded with 6 or 8 inches of coal ashes. There will be a right-angle bend about 100 feet from the starting point, and another bend nearly at right angles about midway of the line of pipe, and a total rise of about 20 feet. The steam pressure in the boiler is about 90 pounds. Kindly let me know if you consider this plan practical, and whether there is a better way to protect the pipe. Also, give the diameter of the pipe. *A.*—Your plan is practical, but if possible it should be avoided, as there is always more or less loss connected with it. The wrapping around the pipe, we believe, will not give the best results. We understand that the Holly Company, of Lockport, N. Y., has used a steam pipe 3 inches diameter and 1,600 feet long, laid on a descending grade of 20 feet, with lower end trapped for water, and a constant steam pressure of 20 pounds maintained at each end as near as it was possible to measure it. During 12 hours the water condensed was 82 pounds per hour. This is equivalent to .179 of a pound of steam at 20 pounds pressure condensed per square foot of actual outside surface of pipe. With higher pressures the condensation will be greater per unit of surface, increasing in a ratio presumably about as the increase of pressure of steam. The manner of preparing the pipe, and the conditions under which it was placed are as follows: The pipe was wound with asbestos followed by hair felting, porous paper, manila paper, and finally thin strips of wood, laid on lengthwise, and the whole wound by copper wire, and placed in a wooden log bored to have an air space between the pipe and the log. The whole was laid in a trench in the ground, and an earthen drain pipe placed below it to carry off the water from the ground. In order to give the diameter of the pipe, we should know the weight of steam required per hour, but on general principles we should say that a 3-inch pipe will be large enough. The pressure of the steam delivered through this pipe will be about 10 pounds less than the pressure in the boiler.

(227) W. S., South Milwaukee, Wis., writes: Kindly show me how to compute the bending moments for the shaft shown in sketch with the pinion C placed in different positions. The vertical resistance at the circumference of the pinion is 25,000 pounds. The length of the shaft is 7 feet from center to center of bearing, and in one position the center of the pinion C is placed at 1.5 feet from the center of the bearing A. *A.*—The first step will be to find the vertical pressure on the journal A by the following formula:

$$P = \frac{W \times b}{l}, \qquad (1)$$

in which P = vertical pressure on the journal A, W = the vertical pressure on the shaft due to the resistance = 25,000 pounds assumed to be applied at the center of the pinion, b = the distance from the center B to the center C, and l = the distance between the centers of the journals A and B. Now substituting for the letters their values, we have

$$P = \frac{25{,}000 \times 5.5}{7} = 19{,}642.85 \text{ pounds}.$$

Multiply this pressure by the distance between the centers A and C, the result will be the bending moment at C. Let us denote the distance between the centers A and C by a, and M = bending moment, then we have

$$M = P \times a, \qquad (2)$$

from which we get

$$M = 19{,}642.85 \times 1.5 = 29{,}464.27$$

foot-pounds for the bending moment at C. The same result would have been obtained if we had found the pressure on the journal B instead of on A. Thus the pressure on the journal B is found by the following formula:

$$P_2 = \frac{W \times a}{l}, \qquad (3)$$

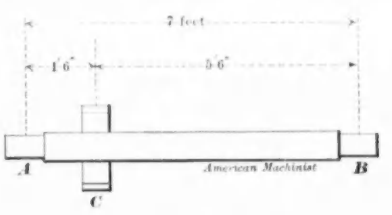
in which P_2 = pressure on the journal B, all the other letters denote the same quantities as before. Substituting in formula (3) for the letters their values we have

$$P_2 = \frac{25{,}000 \times 1.5}{7} = 5{,}357.14 \text{ pounds}.$$

Multiplying this pressure by the distance b we have

$$5{,}357.14 \times 5.5 = 29\,464.27$$

for the bending moment at C, which is the same as before, as it should be. In a similar way the bending moment for any other position of the pinion can be found. 2. Suppose we place a drum on the same shaft whose center is 3.5 feet from the center B without making any other change, the vertical pull on the shaft due to the drum is 50,000 pounds, what will be the bending moment under these conditions? *A.*—We shall



assume that the pull due to the drum is applied at the center of the drum. First find the pressure on either journal due to the pull of the drum, let us find the pressure on B. For this we use formula (3) remembering that now a = distance from the center of the drum to the center of the journal A, and W = pull due to the drum. From this we get

$$P_2 = \frac{50{,}000 \times 3.5}{7} = 25{,}000 \text{ pounds}.$$

Inspection would have shown us that since the pull of the drum is applied at the center of the shaft each journal must support one-half of the weight of 50,000 pounds; hence in this particular case formula (3) need not have been used, we used it simply for the purpose of showing its application. Add this weight to the weight on the journal B due to the resistance of the pinion, we thus get $25{,}000 + 5{,}357.14 = 30{,}357.14$ pounds. Multiply this weight by distance from the center of the journal to center of the drum, the result will be bending moment at the center of the drum. From this we get $30{,}357.14 \times 3.5 = 106{,}249.99$ foot pounds for the bending moment. For the bending moment at the center of the pinion C add 25,000 pounds to weight on the journal A as previously found; this gives us $25{,}000 + 19{,}642.85 = 44.642.85$ pounds for the total pressure on the journal. *A.*—Multiply this pressure by the distance between A and C, the result will be the bending moment at C. Thus

$$44{,}642.85 \times 1.5 = 66{,}964.27$$

for the bending moment at C.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 432.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Cam-Milling. Machine Tool Works, Newark, N.J.

Marine Iron Works, Chicago (new catalog).

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engine Castings, 1 to 6 Horse-power Vertical. The Humphrey Foundry, Bellefontaine, Ohio.

American packing rings are in touch with the cylinder. New circular about rings and pistons. J. H. Dunbar, Youngstown, O.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Machine work solicited; complete equipment modern machine tools; patternmaking, designing, experimental work; tech. assistance if required; best facilities & very reasonable prices. P. Pryibil, 512-524 West 41st St., N. Y.

Just Published—"The Modern Machinist," by John T. Usher. Price, $2.50. Each of its 257 illustrations represents a new device in machine shop practice; a new book from cover to cover; agents wanted in every machine shop; send for special illustrated circular. Norman W. Henley & Co., 132 Nassau street, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

The Shops of the W. F. & John Barnes Co.—II.

BY JOHN RANDOL.

Continuing the description of things seen in the shops of the W. F. & John Barnes Co., Figs. 11 and 12 show front and rear views of a traversing head milling machine carrying a face mill of considerable size, with an entirely novel form of individual teeth. Each tooth consists of a round disk of tool steel, carried on a substantial shank. These shanks go in seats in the edge of the cast-iron cutter body, and are secured by ordinary turret tool binders against rotation. These shank holes in the cutter body are less than half the diameter of the disks carried by the shanks from the front face of the cutter body, so that when the shanks are in place the edges of the cutters project beyond this front face of the cutter body. These projecting disk edges are notched out in one place to form a single cutting tooth, and it is only needful to set the edge of this single tooth as far to the front as possible to bring all of the cutting edges in one plane, provided the shank holes are all drilled in one plane, and the outer diameter of the cutter disks is the same. The cutter disks are not solid on their shanks, but are threaded on and screwed down hard; grinding these individual disk teeth changes the radial position of the cutting edge with relation to a fixed line on the shank; therefore, the shank-holding binders must be loosened when the cutters are ground and screwed back hard on their shanks, so as to bring the cutting teeth to the extreme front; hence the introduction of the turret binders to hold the cutter shanks in any required

position. This face mill spindle is driven by a worm and worm gear. The long pinion *P* gives an end adjustment direct, by screwing a sleeve gear along an externally threaded sleeve secured to the spindle carrying head, the mill spindle being collared to the sleeve gear. The worm drive for the cutter spindle is had in the usual manner from a splined shaft, and the feed is effected by a worm gear driven vertical pinion shaft carrying on its lower end a pinion working in a rack secured to the frame of the machine. In Fig. 11 the mill is shown at work on the inner end of a head block clamped to the stationary angle plate. The traveling head is dovetailed to the top of the bed with angular checks, and the machine is very handy and quick in all its adjustments. The traversing head form of milling machine is well adapted for milling the ends of long pieces, and for light cuts this machine is worthy of attention as having a very cleverly arranged traveling head.

The handle *A* gives a hand traverse to the head stock. *B B* is a swinging carrier lever by which the feed-driving worm is carried in or out of gear with the feed worm gear; when out of gear the crank *A* can turn the worm gear by means of a ring bevel gear on its under side, and a pinion on the shaft of *A*. The feed cone *C* is connected with the spindle driving spline shaft by means of a worm on the spline shaft, a worm gear on a vertical shaft, and a pair of miter gears on the feed cone shaft.

The supporting arm *D*, of the usual form, is, of course, not used with the face mill; it is available when the machine is used with a side mill for splining or surface milling. All the long splining of the shop is done on this machine, which also finishes the ends of all the lathe beds.

This mill tooth offers the advantages of cheap construction and very long life. The disk, or form cutter, which is a simple disk of tool steel turned to the section demanded by the contour of the cut it is required to make, and ground to diameter after hardening, is well known; it is used for forming gear cutters, and is very suitable for making any cut where a certain shape of surface is to be constantly reproduced, because the length of cutting edge available for use by successive grindings is greater than that of any other form of cutting tool occupying the same space. Disks of tool steel having threaded holes in the middle are very readily produced of uniform diameter; it is also very easy to bore the shank seats in the mill body all in one plane; all that is needed is to clamp the mill body to an angle plate under an upright driller, and so long as the angle plate is not moved, drilling and reaming with ordinary care will bring the tooth shank seats in the mill body very nearly in the same plane. If the mill body were put on an angle plate on the face plate of the lathe, and simply turned round to drill and bore and ream the tooth shank seats, they would infallibly come in the same plane. If the shank seats are in one plane in the mill body, and the disk teeth are all of the same original outside diameter, then this disk tooth mill would seem to lack nothing in the way of accurate cutter tooth position; any tooth can be unscrewed from its shank, ground, and replaced without difficulty, so that its cutting edge will be exactly in the same plane with all the other teeth in the mill. All straddle mills of ordinary construction, whether the teeth are solid or inserted, require adjustment after grinding to make the work gauge to width; a pair of straddle mills fitted with this disk tooth would keep their size, no matter how much of the teeth was removed by grinding, and the same effect could be had in a mill for making a slot or sinking cut where the two walls of the cut must be kept at a uniform distance apart, with either double teeth cut in the disks, or two sets of disk teeth, one set for each wall of the cut. It would seem that for sinking or slotting mill cuts of, say, an inch or over in width this disk inserted tooth has valuable advantages. The cuts which I saw made by the disk tooth were all light, with easy feeds, and possibly other forms of tooth are better adapted for rough usage, but this adaptation of the disk tooth to the mill body is, however, valuable in a wide field of operation, and the disk tooth has a very long life, as before stated. This mill tooth is patented.

Fig. 14 gives a view of a drop hammer built at these shops for their own use. This hammer, though of a common form, is interesting because of the simple and good lifter action framing bolted directly to the top of the uprights, and the simplicity of the pawl release at the top of the hammer stroke. In hammers of this class the hammer rests at the top of its stroke, being supported mainly by the lifter crank so far as the weight of the hammer is concerned, but as the crank stands a little past the center the hammer would drop were it not held up by the bell crank stop *S* pivoted at *P*, and having the down hanging rod with a hand eye at *H* pivoted to the free horizontal end of the bell crank lever *S*. If the rod *H* is pulled down the stop *S* is drawn inward past the lifter crank so as to no longer support the hammer which immediately drops, over-running the lifting ratchet *R* as the hammer falls; the lifting ratchet is constantly turning at a uniform velocity, and as soon as the hammer comes to rest at the bottom of its stroke the pawl *P* engages with the teeth of the ratchet driver and carries the crank up to the top of its stroke and a little past, the pawl being at this point lifted out of the ratchet teeth by the "shedder" *Q*. The crank then rests against the bell crank stop *S* as before, ready to begin another blow when released by a pull on *H*.

The hammer shown in these Figs. 14 and 15 weighs 500 pounds and is much too large for the 3,000-pound anvil, as the anvil is only about six times as heavy as the hammer, instead of sixteen times, as it might well be. The anvil stands on four pieces of 12-inch square timber, 6 feet long, standing endwise on a bed of cross timbers laid on the natural gravel. This foundation is entirely insufficient, and the lightness of the anvil for the hammer makes the machine dance when working. A 200-pound hammer would give a better working result; but the general design of the machine is very good indeed; it is only the proportions of hammer and anvil which are faulty, and this is the most common error made in designing drop hammers by men who, although thoroughly up in machine tools, are not perfectly familiar with hammer work. The hammer designer has only to ask the blacksmith why he prefers a heavy anvil to a light one, to be told that the heavier the anvil the more effective the hammer blow and the easier the anvil is kept in place, and all of this is just as true with one hammer as with another; it makes no difference whether the hammer is hand swung or power lifted, the heavier the anvil the better the machine all through.

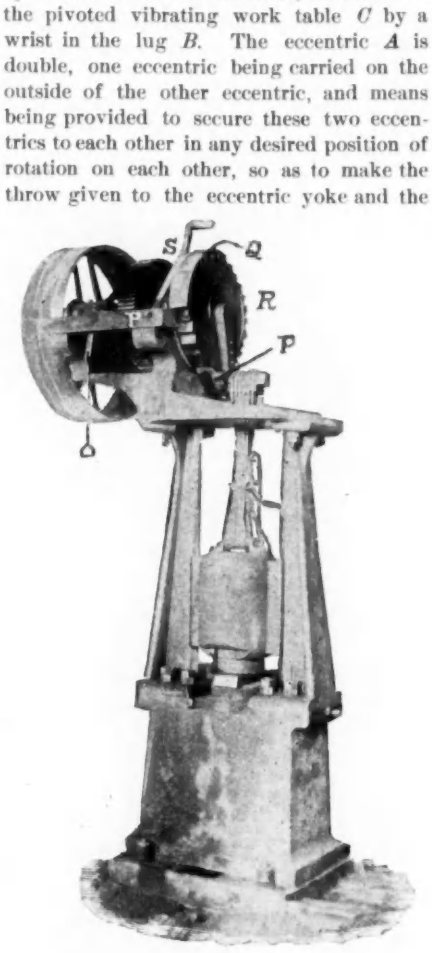


Fig. 14.

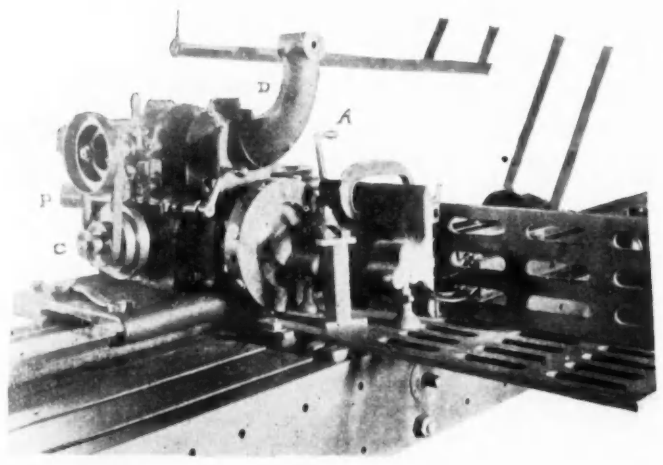


Fig. 11.

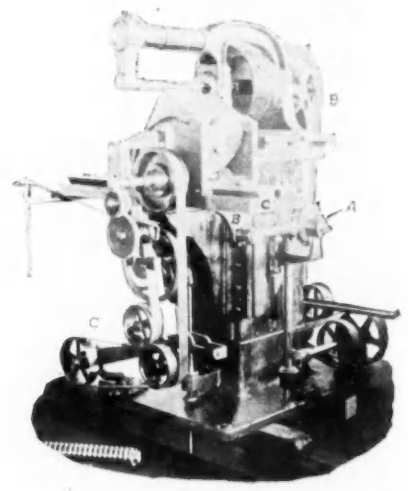


Fig. 16.

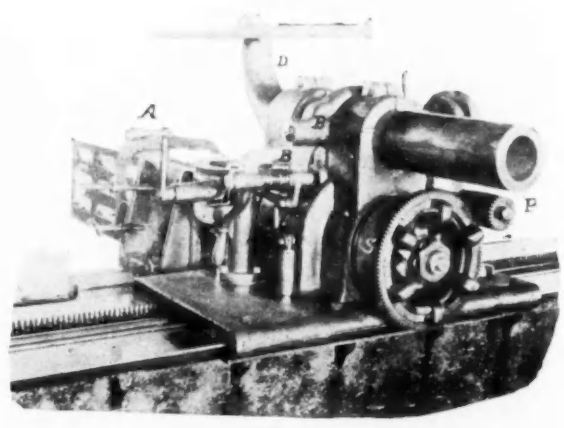


Fig. 12.

SPECIAL MACHINERY IN THE BARNES SHOPS.

In the construction of various machines, and especially in building drills, the Barnes shop uses a great number of bevel gears, which they made until lately in the common manner by milling twice through each cut with a Brown & Sharpe cutter, setting the index head over one way for one cut and the opposite way for the other cut. Mr. Frank Barnes finally discovered a method by which the gear blank could be in effect set on two different angles to the line of slide travel at the same time. This apparent impossibility is attained as shown in Fig. 16 by the use of the eccentric *A*, connected to the pivoted vibrating work table *C* by a wrist in the lug *B*. The eccentric *A* is double, one eccentric being carried on the outside of the other eccentric, and means being provided to secure these two eccentrics to each other in any desired position of rotation on each other, so as to make the throw given to the eccentric yoke and the work table either nothing or double the throw of either of the eccentrics taken alone. The machine is of the pillar and knee and traversing head type combined. The location of the gear to be cut with relation to the center of vibration of the sliding head table is not governed by the pitch cone of the gear, as might be naturally supposed, but is wholly a matter of trial, since it depends on the shape of the cutter tooth. The cutters used are the same that Brown & Sharpe furnish to cut an approximately correct bevel gear by two cuts to each tooth The machine is set so that the teeth will come the right shape at the large end, and the small end is made the best that can be produced by trial settings of the machine; the space at bottom at the small end of the tooth is made correct. In the gears that I saw cut the tooth was too wide outside at the small end, and had to have a very little shaping with the file at the point on each side to make them run smooth. I had no opportunity to give the action of this novel machine any thorough examination, hence I can express no opinion as to what it might be made to do with a cutter of a form precisely suited to the requirements of this new combination of movements. The practical results were easy enough to understand. Before the introduction of the "vibrator" or "oscillator" four gear cutters were employed steadily on this work, and some of the time five; the "oscillator" now does all the work done by the four or five ordinary machines previously, and makes precisely the same grade of work made by the ordinary machines; no better and no worse, and this job of bevel gear cutting, which was previously always behind, is now right up to the requirements, greatly to the satisfaction of all concerned. The machine is entirely automatic, the usual gear blank revolving mechanism being employed. The number of oscillations of the blank from side to side bears no fixed relation to anything else. With the driving belt on the middle step of the cutter spindle cone the vibrations were 48 per minute and the spindle revolutions were 60 per minute, making the ratio of oscillations to spindle revolutions (which is fixed) as 4 is to 5. The highest feed rate obtainable on the machine is 0.0125 inch per spindle revolution. The oscillating motion is obtained from the pulley *B* on the extreme rear end of the cutter spindle. The blank revolving action is taken through the belt *B* also, and carried by a horizontal shaft to the front of the machine. The blank carrying head is mounted on a slide which is bolted fast to the top of the knee. The blank holding head is of the Brown & Sharpe index machine type. The traverse action of the cutter spindle head stock is, of course, made automatically reversing so that the machine will cut a gear without attendance. This machine has been recently patented, and is believed to be a pioneer and unique in action.

It is certainly a great time saver, and the work produced is as good as can be made with twice the number of cuts on a common gear cutter. As might be expected, the cutter works easily and will run as long or longer without grinding as it would on ordinary gear cutting machines. The oscillating eccentrics, blank holding head and cutter spindle head are all graduated, and a record is kept of the graduation settings for each gear made, so that it can be reproduced at any time.

Our English contemporary, *The Mechanical World*, reproduced from our issue of March 28th, our engraving and description of Mr. S. M. Balzer's device for backing-off

milling cutters in a lathe, in which is used what we consider, and still think is, an entirely new device in the way of gearing, *i. e.*, a sun and planet motion, one of the gears of which is indexed for a greater number of teeth through half its circumference than through the other half, this resulting in an intermittent circular motion. Upon the republication of the matter in *The Mechanical World* a correspondent of that paper writes to say that the device is an old one, and that he had used it previously, but his letter evidently implies that he had used merely the regular differential sun and planet motion, which is common, and results simply in a very great reduction of speed with few gears; not in the intermittent motion of Mr. Balzer's device, which we believe to be one of the few really new things in mechanics.

Another Remarkable Broaching Job—A Limit Gage for Worm Threads.

We present herewith some tools which we consider excellent examples of the methods pursued in modern and advanced manufacturing operations for the production of machinery which is made strictly interchangeable in large numbers.

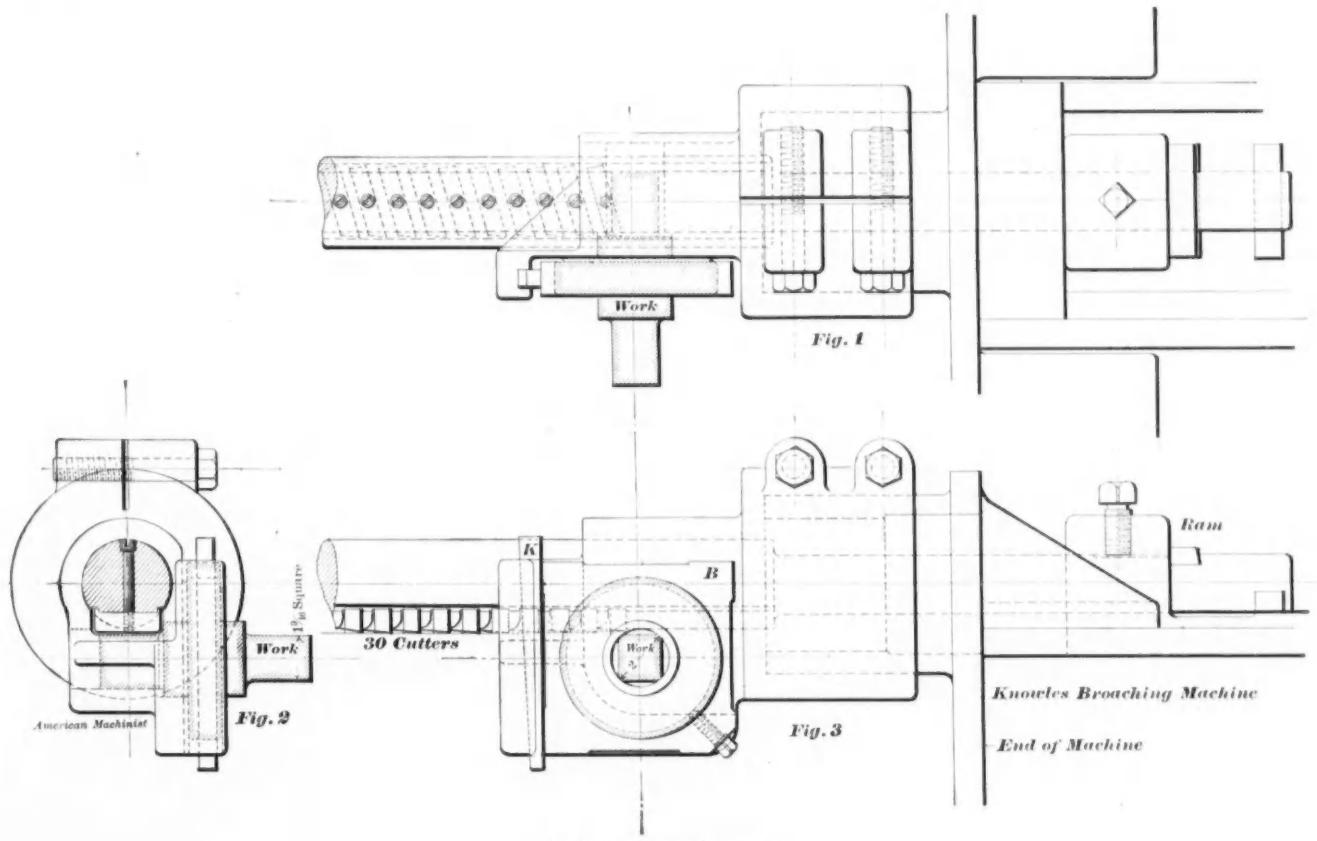
In our issue of Sept. 13, 1894, we gave some illustrations of what we think likely is the largest and heaviest broach ever made. It will be remembered that this was for broaching square holes in the chain sheaves of the new Harrington hoist, which we illustrated and described in our issue of Feb. 7th.

The same machine which is used for this broaching job is also utilized for squaring the ends of the shafts to receive these chain sheaves; the fixture and broach for the work, as designed by Mr. J. A. McGregor, being shown by the accompanying engravings, Figs. 1, 2 and 3, which are respectively plan, end view and side view. The broach in this case has teeth on one side only, and they are fitted into slots cut diagonally across the bar, as shown in Fig. 1, the method of securing them being more plainly indicated in Fig. 2. The work, which, as it comes to the machine is a worm wheel blank and shaft of the form indicated, is put into a square block *B* (Fig. 3) of steel, which has a hole bored through it just to fit the worm wheel blank. The outside of the block being square, it is inserted in the fixture and held by the taper key *K*, while the broach is drawn through the fixture and thus slabs off one side to a finish. The square block then serves to index the work for the other positions to complete the squaring, and the work is, of course, very rapidly and well done.

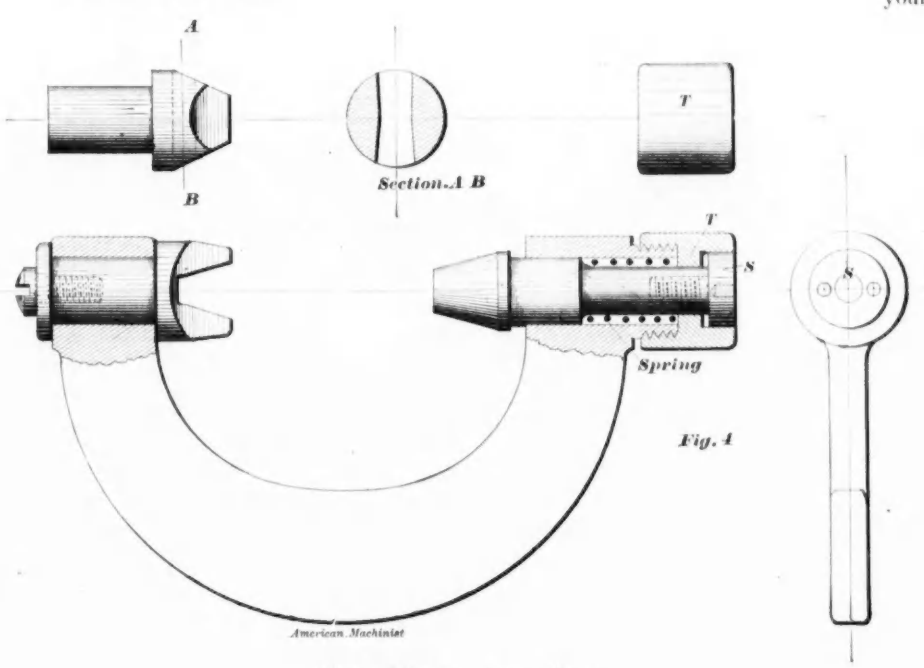
Only one bar is used for all the different sizes of hoists, though, of course, a separate fixture is used for each size. There are 30 cutters in the bar, and their hight is made to govern the amount of metal removed by each one, and the size, which is finally gaged by a limit gage, one end of which is standard or exact normal size, while the other is .0015 inch under standard. As the work and the bar both fit the same fixture at points close together, there can be no springing away from the cut. The last two cutters determine the size, and these can be packed out with paper if required. On the smaller sizes only 15 cutters are used, the others being removed and the stroke of the machine that much reduced.

It is almost impossible for the operator of the machine to make a mistake in indexing, and by simply reversing the square block *B* and the work end for end without separating them from each other, the squares on the two ends correspond, *i. e.*, have their respective sides in the same plane.

In preparing for the systematic manufacture of the new hoist, limit gages were made for every part, the dimensions of which are



A BROACHING FIXTURE.



WORM THREAD LIMIT GAGE.

form of bow and has an anvil fitted so that it swivels freely in the bow. This anvil fits over a thread of the worm, while the opposing contact piece is conical and fits between the threads.

At the start of this job, it was supposed, naturally enough, that a gauge made in this way could be pulled off the worm without being opened, but a little experience showed this to be a mistake, and the conical contact piece was arranged to push back against the resistance of a helical spring, as shown. The outer end of the plunger so formed is drilled and tapped for a screw *S*, and the head of this screw is a free fit in the enlarged hole in the thimble *T*, which is threaded internally and fitted to the frame, as shown, being screwed firmly against a shoulder. The top surface (the right-hand end in the engraving) of this thimble is not a continuous plane, but one-half of it is lower than the other half by just the amount of the allowance of variation in the worms, and when the gauge is applied to a worm, the top of screw *S* must not be below the low side of *T* nor above the high side. All these surfaces are ground smooth, and by passing a finger over them it is instantly known whether the screw-head is between the limits or not. This tool gages the worm where its size is important, the outside diameter being, of course, gauged previously by the ordinary method.

of any importance, and among these is the form of gage shown by Fig. 4, which at first glance is likely to be taken for a micrometer gage, though it really makes no use of the micrometer principle.

It is for gaging worms and is arbitrary, *i. e.*, a worm is first made by careful measurement and known to be right, then this gage is made which has the micrometer

Experience with this tool shows that the teeth stand much better than milling cutter teeth on the same class of work, probably because springing and vibration are avoided.

Grinding with Emery and Corundum Wheels.

BY C. H. NORTON.

There are perhaps no tools in common use so little understood and so misused as emery wheels and grinding machines. Many are the notions, and great is the prejudice to be overcome in introducing surface and cylindrical grinding machines for cheapening and perfecting machine and tool work, and machines for grinding tools in place of the grindstone. On the one hand, are people who assume to know that the grindstone is a back number, and that machine grinding on universal and surface grinding machines does really give economy as well as accuracy, while there are others who think they know the reverse is true, and each will prove it by personal experience.

Lavater has said, that "thinkers are scarce as gold, but he whose thought embraces all his subject, who pursues it uninterruptedly and fearless of consequences, is a diamond of enormous size." In this connection let me say that experience is more valuable than gold, but he whose experience has embraced all the subject, who has pursued it uninterruptedly and fearless of consequences, is more valuable in the settlement of these problems than those who allow themselves to be deceived by the use of only a part of the factors in the problem and their solution to be colored by their former opinions.

From the tone of the letters on this subject, published in the AMERICAN MACHINIST some time ago, we cannot fail to see the force of this truth. Many of them noticeable for the absence of all proof of research on the part of the writers, others use the time honored argument of "I told you so," while some show careful thought. Allow me to recall those letters, and I will mention that of Professor Sweet, where he tells of the failure of the emery wheel and of his return to the good old-fashioned grindstone. You may remember that he appeared to have settled the question for all time. You could almost hear that tool grinder as it tumbled over onto the scrap heap, and one waited for the bass drum to embellish the last grand thump as it strikes the side of the back shed behind the scenes. You may recall also the long line of executioners who pounced upon the poor thing and pounded away at it after it was apparently dead.

The writer feeling sympathy for the poor tool grinder, especially when he had been so well served by the emery wheel, ventured to ask some questions which were published in your paper at that time. They were asked hoping some one would answer them or a part of them, believing that the correct answer to them would do much toward settling the differences on this question, but although that was nearly four years ago, they still (so far as I know) remain unanswered.

One writer tells of the flying to pieces of an emery wheel, severely injuring the young man who was grinding. Perhaps the same thing ailed this wheel that ailed one on a grinding machine I once knew of.

This wheel had stood the test of time, and its makers were surprised when told that it had exploded, doing damage to the machine and work. An investigation disclosed the fact that the wheel instead of being run at 3,000 revolutions as directed (through speed given for overhead works) was actually run at about 12,000 revolutions. In order to get this high speed, the mechanic changed the construction of the machine assuming that the makers were incompetent to judge as to the proper construction.

I am familiar with a number of cases where parties have ordered wheels to do a certain specified work upon specified machines. These wheels were furnished by the people making and using these machines doing the same work constantly, were selected by persons most familiar with the

facts, and sometimes taken out of one of those machines where they were actually doing that same work satisfactorily, both as to quality and quantity, yet they have been returned as worthless.

A concern asked advice of an experienced works as to the best wheel for certain work; one that was made on purpose for that work and known to be a success was sent them with instructions as to use. In a few days the pieces were returned with the information that it was "rotten, please send one that is sound." That quality they called rottenness was just what made it successful where all others had failed. Instead of the rottenness being an accident, it was obtained at a cost of considerable time and money.

A machine tool concern ordered of an emery wheel maker a special wheel, one was sent that was working well on the same work in other hands; the maker specified the speed, but in a short time he received a request to replace it free of charge as it had broken. Investigation showed that no attention had been paid to the instructions, but that it had been run at double the speed specified. In this case if it had not broken it would have been condemned for heating and glazing.

Another machine tool maker inquired what wheels were best for grinding hard spindles of a certain size. He was told the number of emery, diameter, thickness, speed and grade, and that in case of soft spindles another grade should be used. He afterwards obtained wheels of the same number and grade, but one-half the diameter and thickness, then he used them on soft steel. As a matter of course they wore right down to the collar in a few hours, consequently that make of wheel was condemned and another ordered.

The Maker of the Chain-Pin Spinning Machine.

In our last week's description of the chain-pin spinning machine, we inadvertently stated that it was manufactured by the Garvin Machine Co., whereas it is manufactured by the Waterbury Farrel Foundry and Machine Co., Waterbury, Conn., the Garvin Machine Co. having the exclusive sale of it.

Surface cars operated by the underground trolley are now running satisfactorily upon the Lenox avenue line in this city. This we believe is the first practical trial of this system in the United States. The Lenox avenue line is a part of the system of the Metropolitan Traction Company, which operates the Broadway cable road, and if the new system proves to be reliable in all weathers it will be adopted in place of the cable.

NEW CATALOGS.

We have received the catalog of the University of Kansas, at Lawrence, Kan. This contains half-tone illustrations of the University buildings, and full information regarding course of study, equipment, etc. The catalog is 5¾"x9".

Messrs. Speidel & Roeper, Reading, Pa., send us a catalog illustrating and describing Speidel's patent economic safety hoists, which are made with capacities ranging from 500 to 30,000 pounds. Sections showing the construction of the hoists are given, and numerous illustrations showing applications to various purposes. The catalog is 4½"x7⅜".

D. J. C. Arnold, New London, Huron Co., Ohio, sends us a small catalog illustrating and describing machinery and supplies made especially for brick manufacturers. These include tempering machines, trucks of various kinds, machine molds, revolving dumping tables, presses for making pressed brick, etc. The catalog is 4"x6".

The Merrel Mfg. Co., Toledo, Ohio, send us a catalog illustrating and describing improved pipe cutting and threading machinery. Various types of such machines are illustrated and described, some driven by hand and others by power. Most of these machines have been illustrated and described in our columns. The catalog is 5½"x8½".

We have received from the Phosphor Bronze Smelting Co. (Limited), 2200 Washington avenue, Philadelphia, Pa., a small catalog, devoted to setting forth the properties and advantages of the "elephant brand" phosphor bronze and other alloys. The qualities and the applications of these bronzes are given, and the catalog will be found interesting to machinery builders who have occasion to use bronzes. The catalog is 4"x6".

We have received from the M. C. Bullock Mfg. Co., 1150 W. Lake street, Chicago, Ill., Catalog 27, 3d Edition, in which is described a new central valve engine, and illustrations are given of a number of recent installations. There are also illustrations of the Gunning & Campbell engine at Belfast, and a large engine in the cotton mill of Messrs. Thomasson & Son, Boulton, England. Some interesting diagrams are given in connection with a letter from Mr. Alexander Siemens, showing the results of tests of the Willans engine and Siemens Bros'. dynamos at Glasgow. In these diagrams are curves of combined efficiency, which will be found of very considerable interest to engineers. The catalog is 7¾"x10½".

The Arthur Co., 86 John street, New York, send us a catalog containing illustrations and description of their improved hoisting machinery for warehouses, Arthur's annular, double, gate valves, shafting hangers of various forms, couplings, exhaust ventilating fans, gear wheels, diamond cutting and polishing machinery, etc. The back cover of this catalog contains an account of what is declared to be the highest piece of steel work on any business structure in the world. It is the flag pole of the Manhattan building, in New York City, which was made by the company named. This flag pole consists of four pieces of extra heavy steel tubing, 9, 7, 5 and 2½ inches outside diameter, and of a total length of 67 feet. Its top is 415 feet from the sidewalk. The catalog is standard size, 6"x9".

MANUFACTURES.

The Hopedale Machine Co., of Hopedale, Mass., will shortly enlarge their plant.

The Nekoosa (Wis.) Paper Co. will shortly begin the erection of a new machine room and a machine shop.

It has been stated that the recently burned paper-mill of Walsh Brothers, at Cuyahoga Falls, Ohio, will be rebuilt.

The Snell Mfg. Co. is erecting a new factory at Sturbridge, Mass., 150x40 feet, to replace the one burned last winter.

James and J. W. Mullen will establish a paper-mill at St. Joseph, Mich., to consist of a building 200x60 feet, two stories in hight.

The Todd's Texas Cotton Picking Co., of Austin, Texas, has been organized with a capital of $250,000. G. N. Todd is president.

The Union Motor Co., of Cleveland, Ohio, has recently been formed with a capital of $10,000. Jas. H. Hoyt is among its incorporators.

The Quoin Mfg. Co., of Chicago, Ill., has been organized with a capital of $50,000. Its incorporators are: E. W. D. Runyan and S. S. Parks.

The Lintania Lumber Co., of Yazoo City, Miss., has been organized and will equip a planing-mill and woodworking plant. Its capital is $50,000.

At Morgantown, W. Va., the Broxton Coal and Lumber Co. has been incorporated with a capital of $300,000. J. B. Ewing is among the directors.

The Keystone Forging Co., of Northumberland, Pa., has been incorporated. Its capital is $30,000. The incorporators are: C. G. and G. R. Van Alen

The Ornamental Steel and Wire Works have been incorporated in Chattanooga, Tenn., with J. K. Kuhn, president. A plant will be equipped and manufacturing started at once.

The new boiler house for the Piercefield Paper and Mining Co., at Piercefield Falls, N. Y., has been completed by the builders of the Berlin Iron Bridge Co., of East Berlin, Conn.

The Rembert Link Cotton Cleaner Mfg. Co., of Galveston, Texas, has been incorporated with a capital of $300,000. A plant will soon be built. Edward McCarthy is interested.

It is rumored that the stockholders of the Spartan Mills have decided to build another mill at Spartanburg, S. C., and will equip it with new machinery at a cost of $500,000.

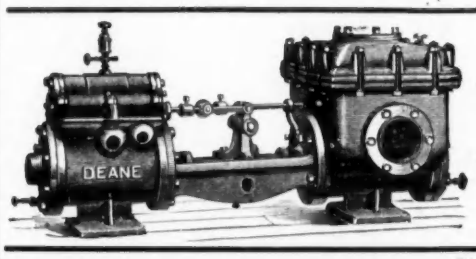
The Berlin Iron Bridge Co., of East Berlin, Conn., is putting up a new car barn for the Wilkesbarre & Wyoming Valley Traction Co., at Wilkesbarre, Pa. The building will be 73 feet in width and 223 feet in length.

The Pittsburg and Tennessee Copper Co., of Ducktown, Tenn., will soon have its plant in readiness for smelting, and will give employment to several hundred hands. D. J. Nelson is superintendent.

The Troy Steel and Iron Company, of Troy, N. Y., is to be reorganized and the works, which have been idle for more than a year, are to be enlarged and started with an increased capital. The plant will make a specialty of merchant steel.

The Egan Co., of Cincinnati, Ohio, write us that they are making some extensive improvements in their already large plant. They are putting in a new electric light plant for 800 incandescent lights, this being in addition to a plant of the same capacity already in place. They report that business is very good.

The Buffalo Forge Co., Buffalo, N. Y., write us that they find that in checking up the number of engines built during the first quarter of 1895, the number exceeds 100 of various types, and they state that they have been unusually busy in their engine department, the entire works having been run full time, and in special departments overtime to keep up with orders. These engines are used mainly with forced draught and heating and ventilating plants, and also for direct coupling to dyna-



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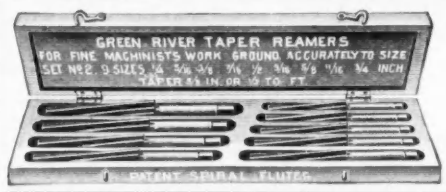

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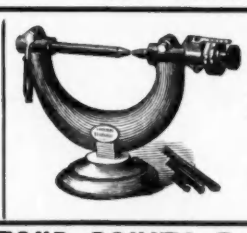

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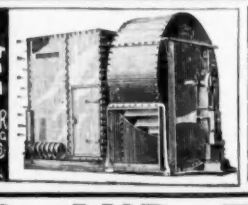

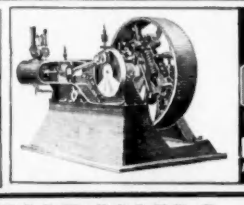

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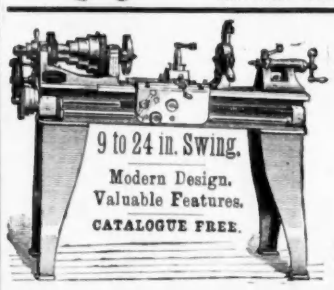

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mos, these last being a more recent departure by this company.

The Pratt & Whitney Company are opening a branch house in Chicago, at the corner of West Washington and Clinton streets, which will be in charge of Mr. Chas. E. Davis, long with the Page Typesetting Machine Co. In this Chicago house the Pratt & Whitney Company will keep a full line of all their work, particularly their small tools, taps, dies, reamers, gauges, etc., for the convenience of Western trade. The new establishment will form a commodious sales and display place for Pratt & Whitney tools solely, no other work being shown there, and is made a necessity by the extensive Western dealings of the concern.

Machinists' Supplies and Iron.

NEW YORK, May 25, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11.25 to $11.50 for No. 2, and $10.50 to $11.00 for No. 2 Plain. Southern brands, $11.50 to $11.75 for No. 1; $11 to $11.25 for No. 2; $10.50 to $10.75 for No. 3; $11 to $11.25 for No. 1 soft; $10.75 to $11 for No. 2 soft; and Foundry No. 4, $10.25 to $10.50.

Antimony—There is no important change in the market. We quote L. X., 8½c. to 8¾c.; Cookson's, 8½c. to 8¾c.; Hallett's 7.10c. to 7½c., U. S. French Star, 7½c., and Japanese, 7c. to 7¼c.

Lard Oil—Prime City we quote at 52c. to 53c.

Copper—The market remains firm, and transactions are fairly large. Lake Copper has changed hands at 10.25c. to 10.35c., but prices recovered and the closing quotations were the same as last week 10¼c. to 10⅜c., and it is said that nothing is now obtainable at figures less than the latter quotations. Casting Copper is held at 10½c.

Lead—The market is fairly active, but prices are somewhat lower. For Spot, 3.20c. to 3.22½c. is quoted.

Spelter—The market is firm, and business has been fair. For New York delivery 3.60c. is quoted.

Tin—The market is active, but prices have fallen. The market closed at 14.75c. for spot, and futures at 12.54c. to 13.28c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Agents traveling and local to sell steam spec's; good commission. Mfr., 1115 State St, Erie, Pa.

Wanted—An exp'd duplex pump salesman. Address, giving particulars, Duplex Pump, AM. MACH.

1st-class die and toolmaker wants temporary or permanent sit.; steady; refs. O. P., AM. MACH.

Young M. E. with exp. wants pos. as designer of steam engs. or gen. mach. Box 185, AM. MACH.

Wanted—One or two men, thoroughly competent to install high speed engines. Box 6, AM. MACH.

Mech. draftsman, age 23, tech. educated, with 3 y'rs office & shop exp., wants pos. Box 9, AM. MACH.

Wanted—A1 patternmaker, one that is a good hand in machine shop. Apply to Astall Iron Works Co., Galveston, Texas.

Wanted—By young mach., work at tool-making under instructions; small pay expected. Box 183, AMERICAN MACHINIST.

M. E. special and hyd. mach. design, tech. education, desires pos. in New England or New York. Box 196, AMERICAN MACHINIST.

Wanted—An electrician to superintend small incandescent light plant, with $2,000 to $3,000 to invest in company in a thriving city in Iowa. Box 7, AMERICAN MACHINIST.

Wanted—Position by a steady temperance young man, as layer out in boiler shop. Best of reference. Address H. N. Mc., care of AMERICAN MACHINIST.

Wanted—A first-class brass molder, experienced in valve castings, to take charge of small iron and brass foundry in Tenn. Box 198, AM. MACHINIST.

Wanted—Position as traveling salesman, by a practical machinist; American; 18 months on road. Box 200, AM. MACHINIST.

Wanted—Two brass finishers, to run a Fox turret lathe in jobbing and steam work; nothing but good men wanted. Apply at Canton Pump Co., Canton, Ohio.

Situation wanted by a first-class toolmaker, experienced on jigs, cutters, dies, fixtures and fine special machinery; fair draftsman; have had charge of work. Box 107, AMERICAN MACHINIST.

Competent mech'l engineer wants responsible position. 15 years exp. on hoisting mach'y. Steam, water power, and electric mach'y. Best refs. from concerns of highest standing. Box 195, AM. MACH.

An energetic man to represent us in N. Y. City; one connected with the boiler or steam pipe business preferred. Holly Steam Engineering Co., 344 Butler Exchange, Providence, R. I.

Wanted—A good blacksmith as tool dresser for a large machine shop, who thoroughly understands his business. When writing, give age, references, and whether married or single. Address Box 190, care AMERICAN MACHINIST.

Wanted—Practical machinist to act as foreman in shop devoted to building special machinery and jobbing; must be a hustler, and have good executive ability; state age, experience, and pay expected. Box 8, AMERICAN MACHINIST.

Foundry foreman, must be thoroughly competent to take charge of shop, making light bench and floor work; one having exp. in making soil pipe and fittings preferred; state experience and references. Box 199, AMERICAN MACHINIST.

Millwright and patternmaker, accustomed to chocolate and coffee mills, repairs, sheet iron work, etc., can construct time and labor-saving devices, and improve quality of product; A1 refs. from present employers. X. Y. Z., AMERICAN MACHINIST.

(*Continued on Page* 434.)

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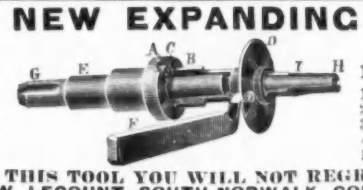

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5 "	3 "	4 "	44

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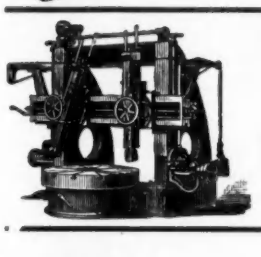

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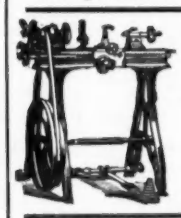

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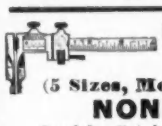

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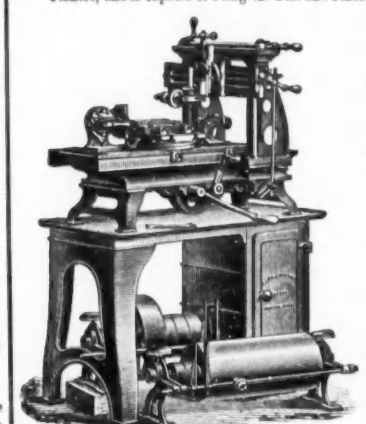

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Washington, Wm. B. Morgan, Room 19, Builders' Exchange.
Chicago, Walch & Wyeth, 208 Lake Street.
New Orleans, Delbert Engineering Co., 23 Union Street.
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LATHES and other METAL MACHINERY

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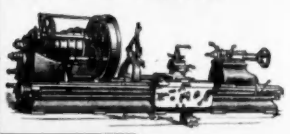

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We can guarantee that our castings will be uniform and of high tensile strength.
Tensile strength of ten specimens taken from an air furnace heat:

34,260 lbs.	34,390 lbs.	32,600 lbs.	33,200 lbs.	34,400 lbs.
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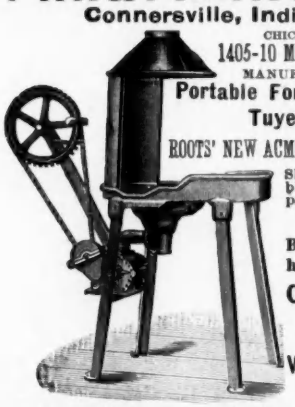

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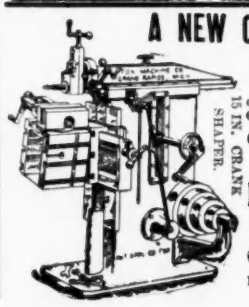

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Length of stroke changed INSTANTANEOUSLY while IN MOTION.
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Cheap 2d hd lathes & planers. S.M.York,Clev'd,O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

For Sale, Cheap—Back numbers AMERICAN MACHINIST; for further particulars address D. C. Morse, 10 Kilby street, Worcester, Mass.

Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

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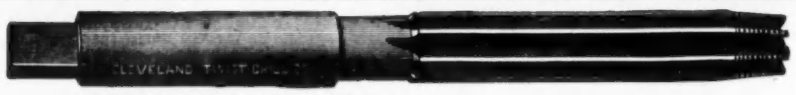
A permanent situa'n in Lancashire (Eng.) is open for a manager in a small toolmaking establishm't employing 150 men; experience in the systematic management of work and men required. Reference given to applicant conversant with mass product'n upon the American system. Write, stating salary required, to T. T., Box P., 52,352 Smith's Advertising Agency, 132 Fleet street, London, E. C. England.



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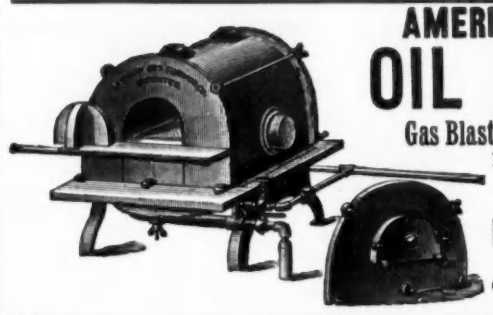

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14 in. x 6 ft. Hendey Taper Att.
14 " x 6 " Flather.
16 " x 6 " Blaisdell.
16 " x 7 " Pratt & Whitney.
16 " x 6 " Perkins.
18 " x 8 " Fitchburg.
20 " x 8 " Pond.
20 " x 10 " Putnam.
20 " x 8 " Prentiss.
24 " x 12 " New Haven.
24 " x 10 " Standard.
24 " x 22 " Perkins
28 " x 16 " Fay & Scott.
32 " x 16 " Waterman.
35 " x 15 " Hewes & Phillips.
43 " x 16 " N. Y. S. Eng. Co.
72 " x 20 " Union.
84 " x 18 " Lincoln.

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Sensitive Drills, Improved.
24 in Bk. Gd Auto. Fd., Prentiss.
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Radials, 3, 4 and 5 ft. Arms.

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Sellers, 54 in. swing, complete
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22 in. x 4 ft. Pond.
24 " x 4 " Wood & Light.
24 " x 5 " New Haven.
30 " x 7 " Pond.
30 " x 10 " Harrington.
42 " x 10 " Gleason.
60 " x 24 " N. Y. S. Eng. Co.
64 " x 10 " Pond.

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8 in. Stroke, Crank Motion.
15 " " " " Fox.
16 " " " " Prentiss.
16 " " " " Standard.
14 " " Trav. Head, with centers, circular feed, Fitchb'g.

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BOILER BENDING ROLLS.

6 and 8 ft.

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Pratt & Whitney No. 2, Wire Feed.
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Gray Planers "NEW," 22, 24, 30 and 36 in.
Kempsmith Millers, Universal and Plain.
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14 in. x 4 ft. Blaisdell, Taper.
16 in. x 6 ft. Perkins, Taper.
16 in. x 8 ft. Perkins, Taper.
16 in. x 8 ft. Blaisdell.
18 in. x 10 ft. Blaisdell.
28 in. x 30 ft. Perkins.
37 in. x 14 ft. maker unknown.

PLANERS.

16 in. x 16 in. x 4 ft. Hendey.
22 in. x 22 in. x 4 ft. L. W. Pond.
24 in. x 24 in. x 5 ft. Putnam.

SHAPERS.

10 in. Pratt & Whitney.
12 in. Juengst, Crank.
15 in. Juengst Friction.
10 in. Wood and Light Traverse Head.
18 in. Putnam, Traverse Head.
18 in. Smith & Silk, Crank.
21 in. Smith & Silk, Shifting Belt.
20 in. Gould & Eberhardt.
24 in. Hendey, Friction.

HAND LATHES.

4 10 in. x 41 in. Garvin.
1 12 in. x 4 ft. Stewart Pattern.
1 12 in. x 5 ft. Pratt & Whitney.
1 12 in. x 5 ft. Back Geared.
1 20 in. x 8 ft. " "

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Garvin Profiler, one spindle.
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5 in. Cutting-off Machine.
No. 2 Springfield Tool Grinder.
No. 1 Garvin Screw Machine.
No. 1 Brown & Sharpe Screw Machine.
No. 3 Garvin Screw Machine.
21 in. Squaring Shear.
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250 lb. Gould & E. Drop Press.
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No. 2 Garvin Wire Spring Coiler.
Several Woodworking Machines.

Also, a large number of other machines. Write for complete list, detailed descriptions and prices.

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SPECIAL SALE OF New Planers

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One Smith-Silk Planer, 24" x 24" x 7 ft.
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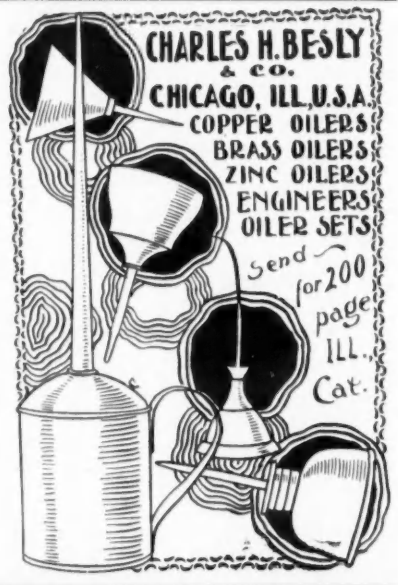

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Two (2) 5 ft. Universal Radial Drills.
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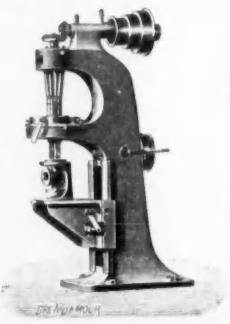

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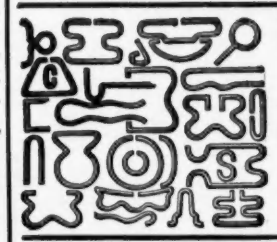

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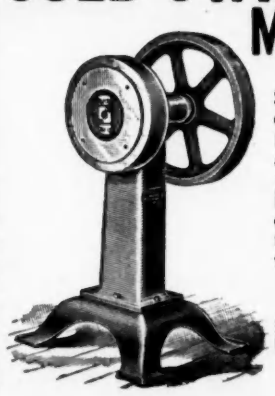

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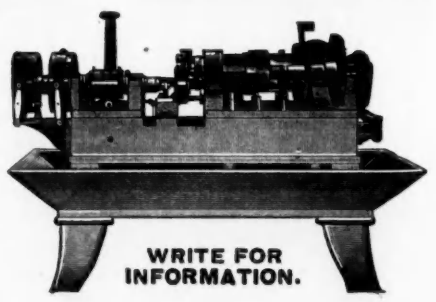

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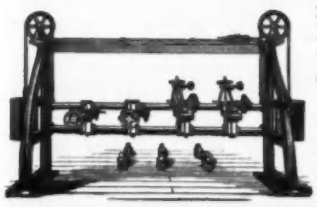

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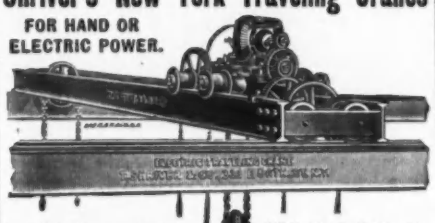

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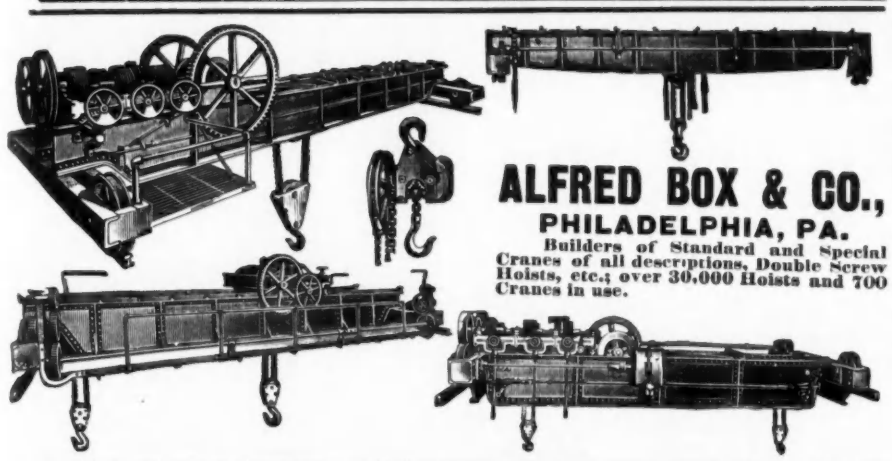

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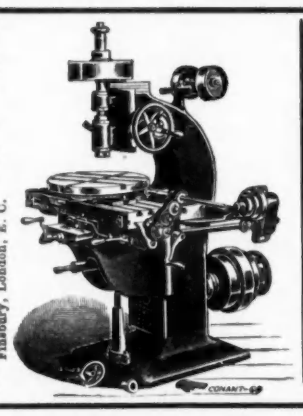

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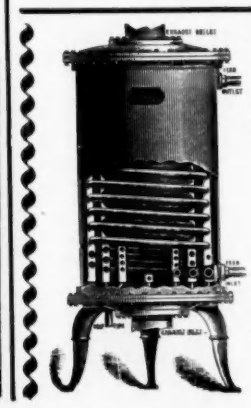

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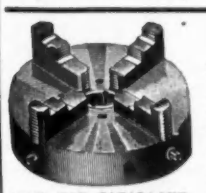

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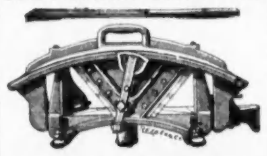

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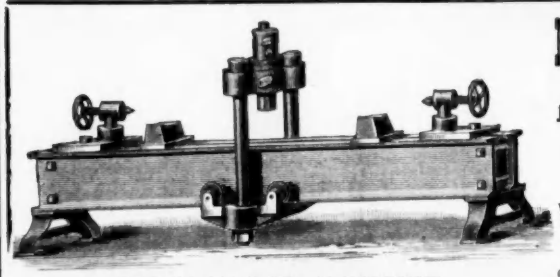

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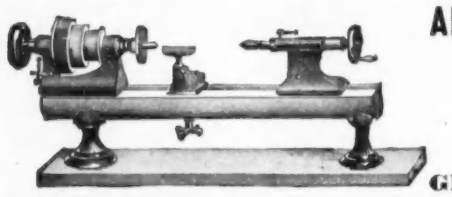

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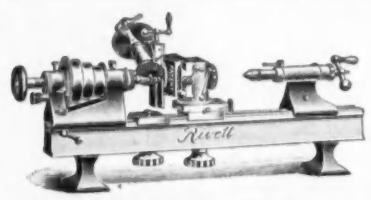

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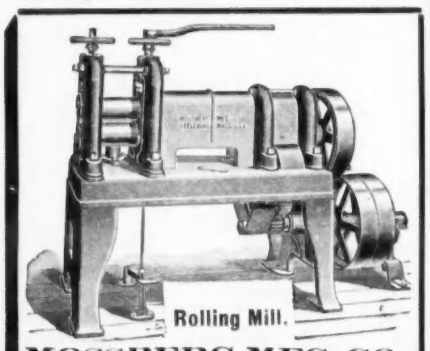

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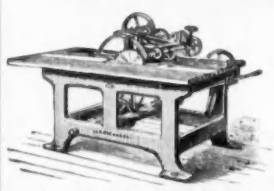

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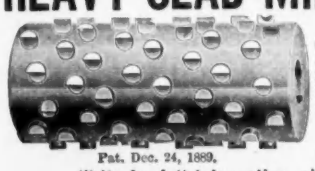

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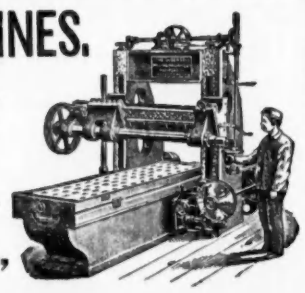

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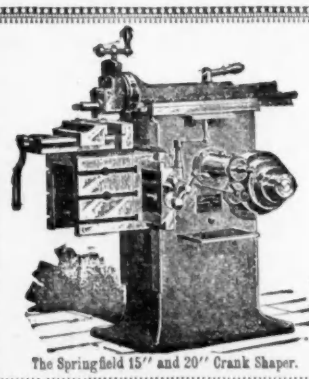

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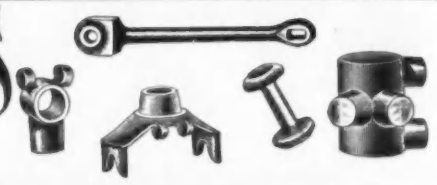

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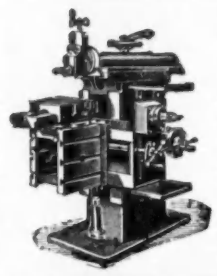

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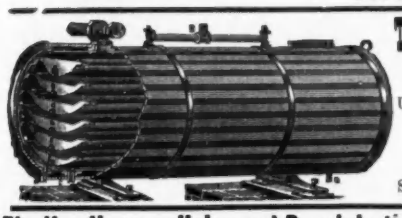

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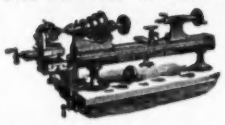

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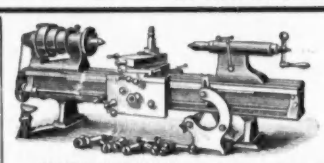

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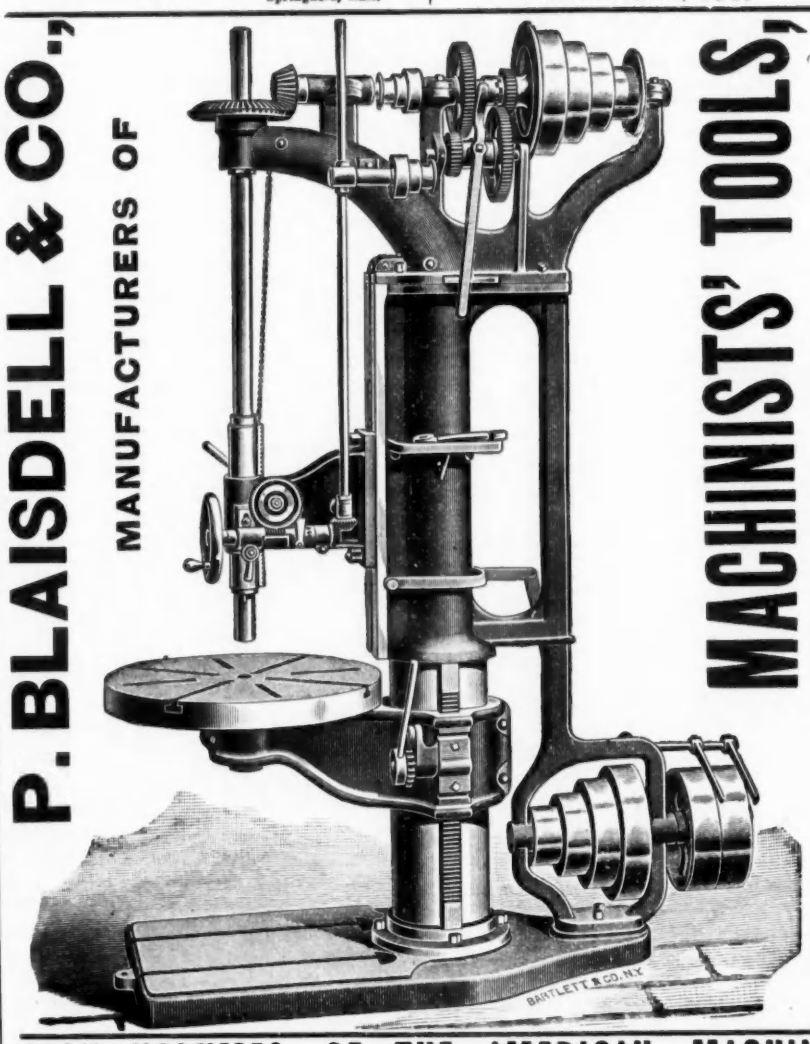

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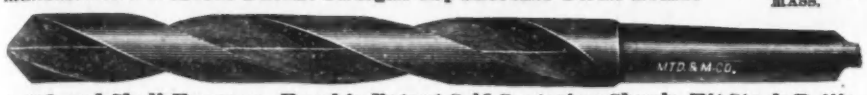

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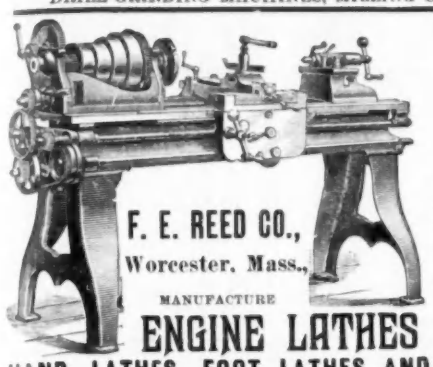

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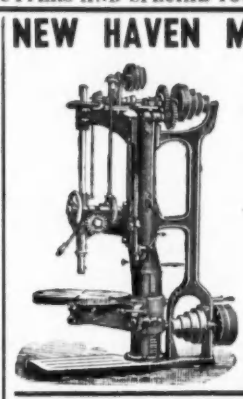

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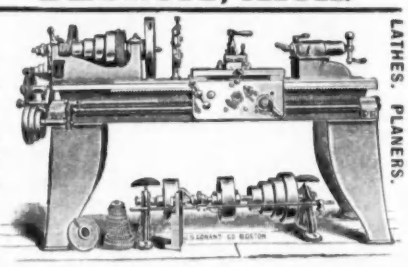

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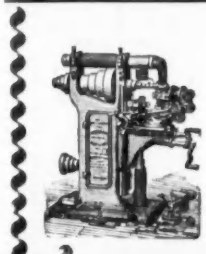

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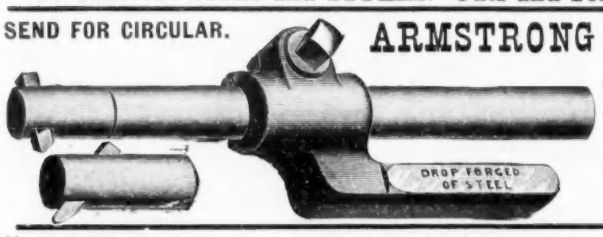

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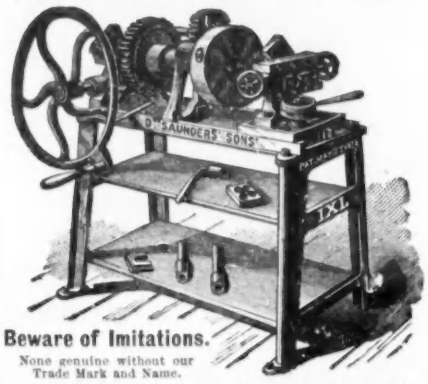

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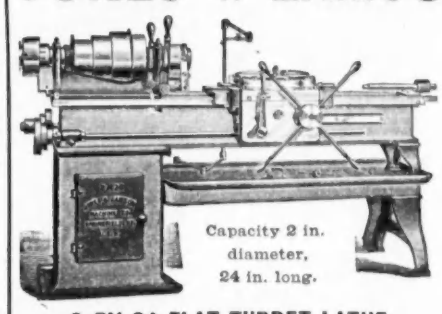

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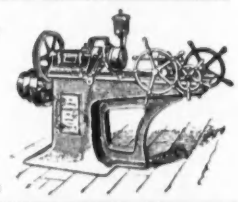

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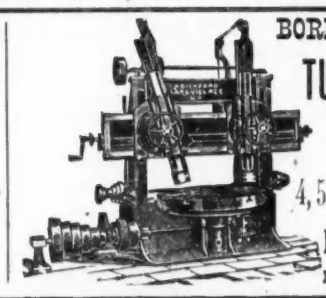

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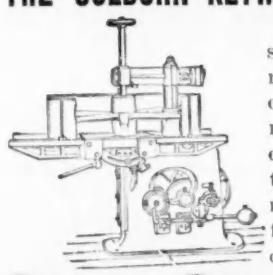

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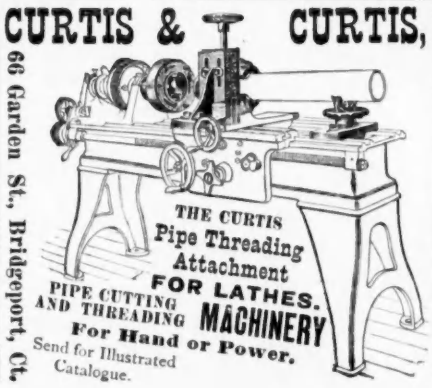

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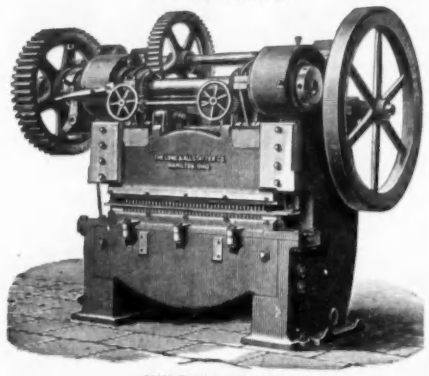

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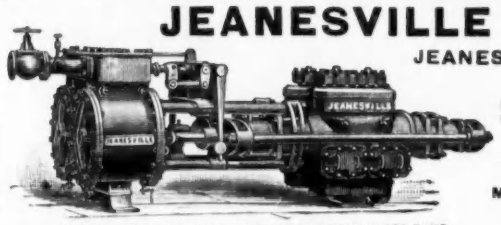

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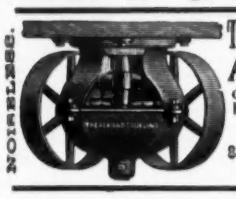

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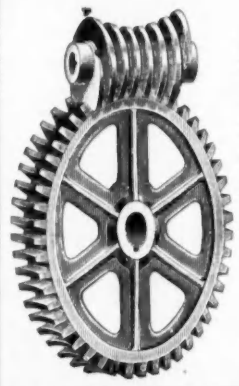

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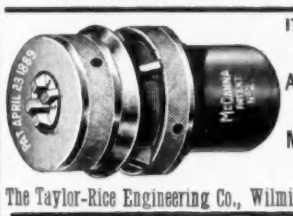

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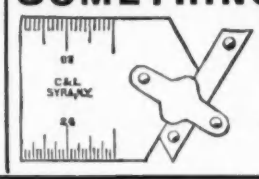

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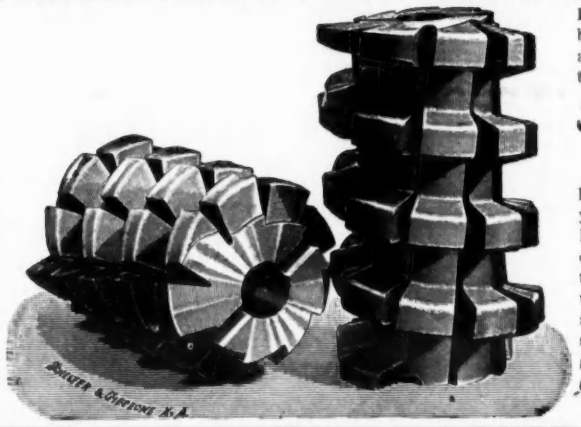

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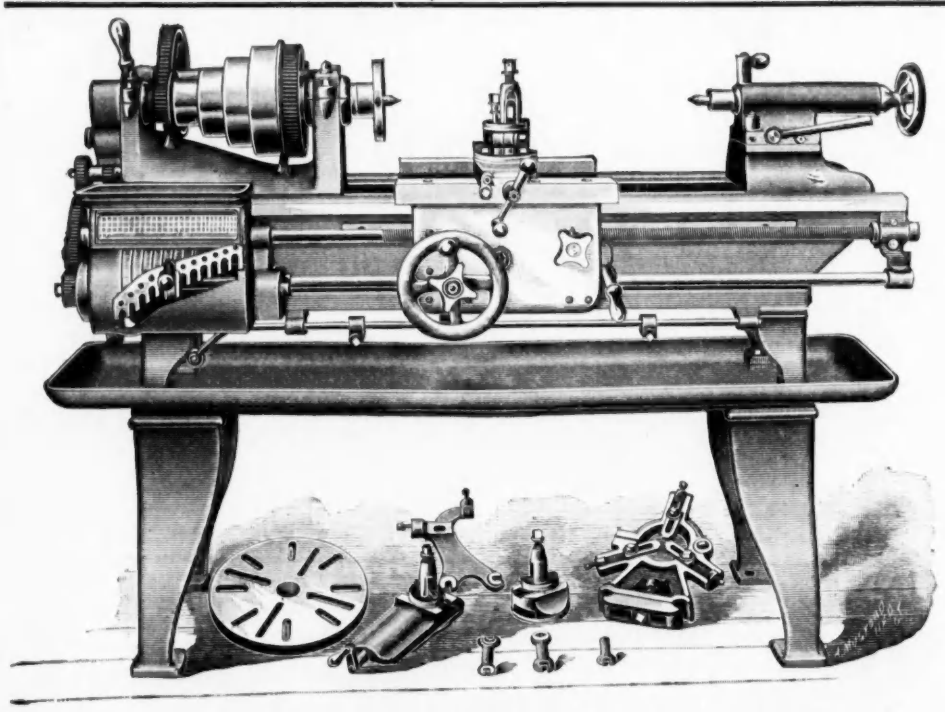

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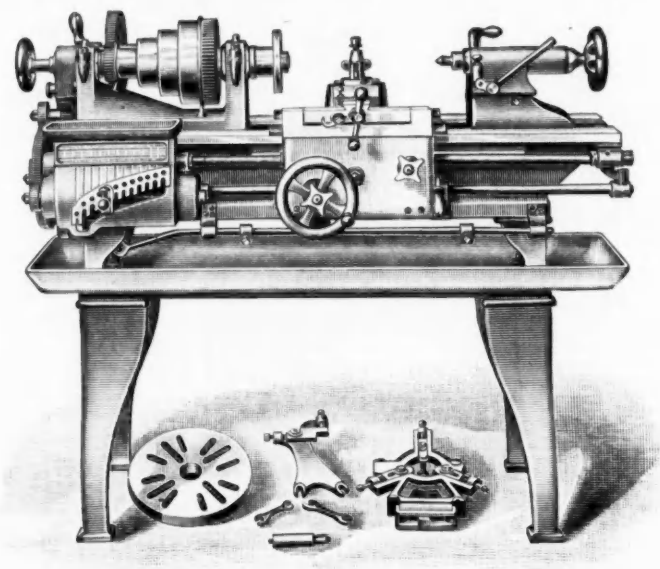

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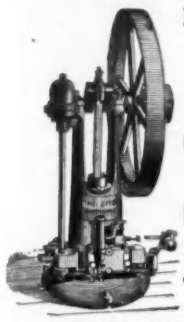

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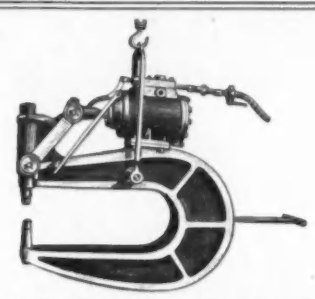

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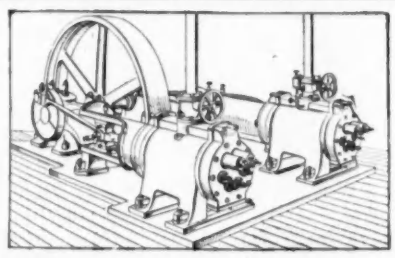

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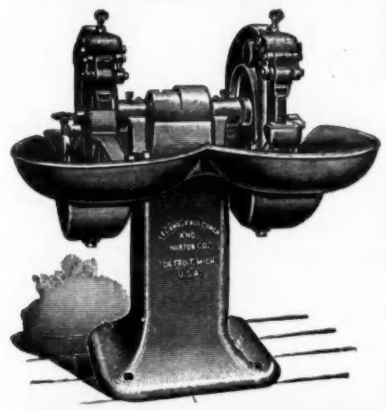

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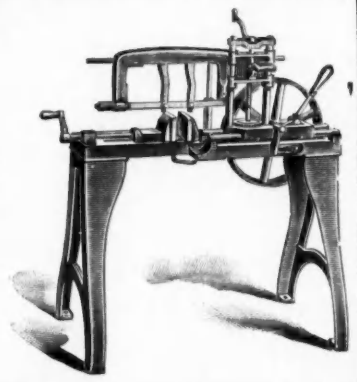

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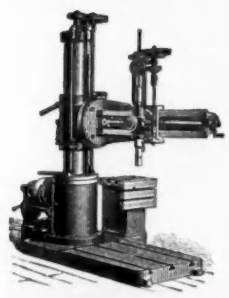

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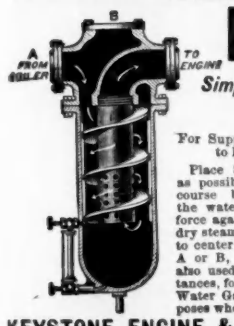

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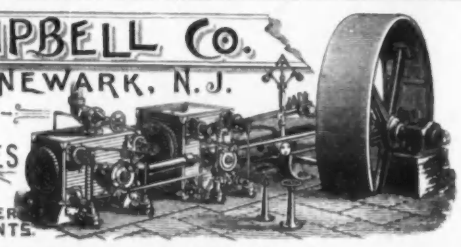

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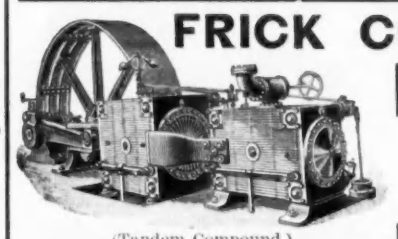

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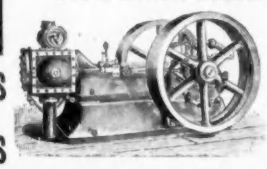

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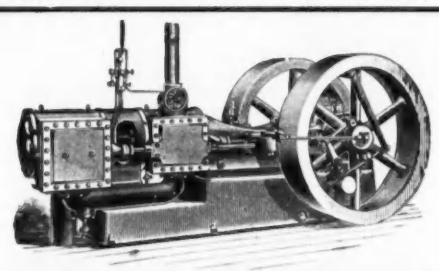

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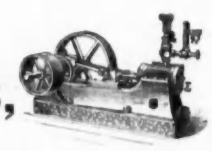

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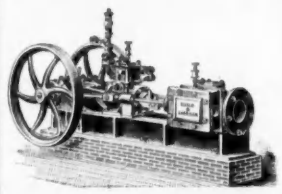

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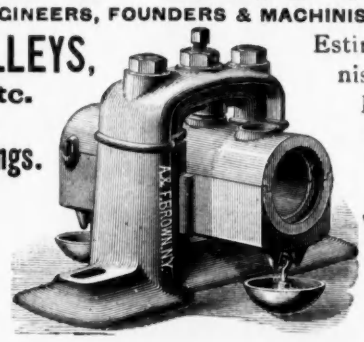

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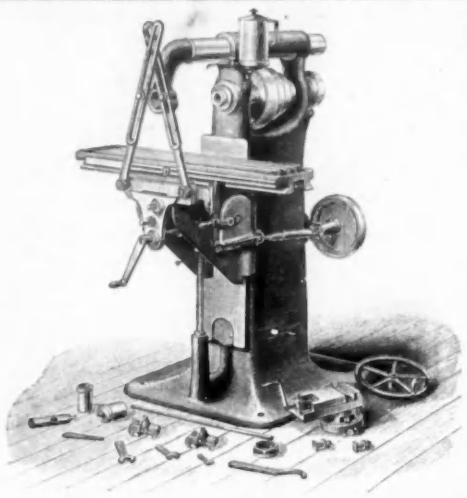

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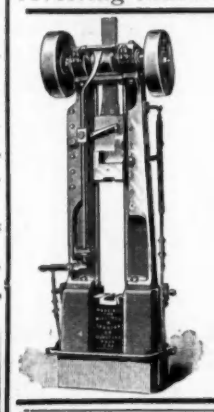

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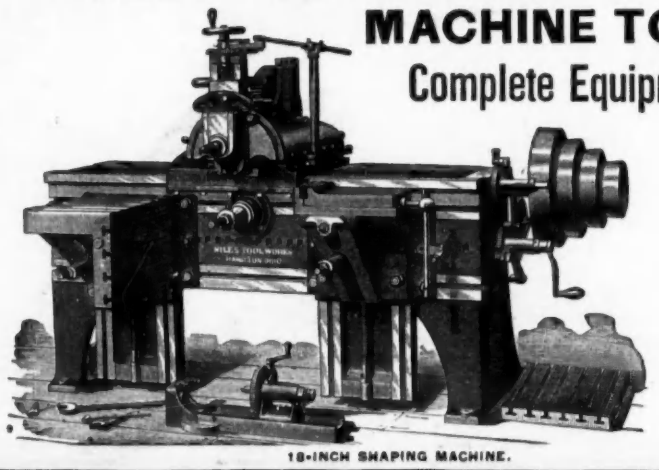

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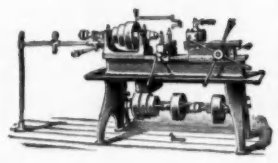

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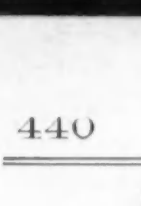

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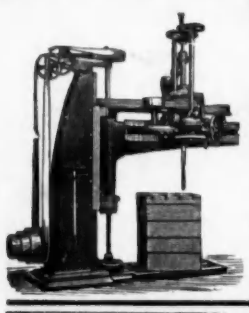

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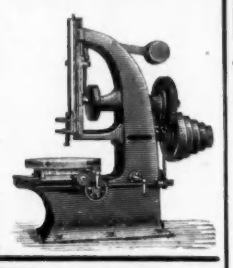

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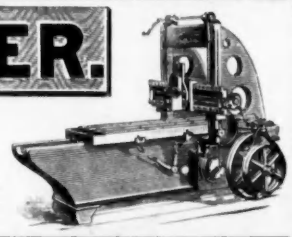

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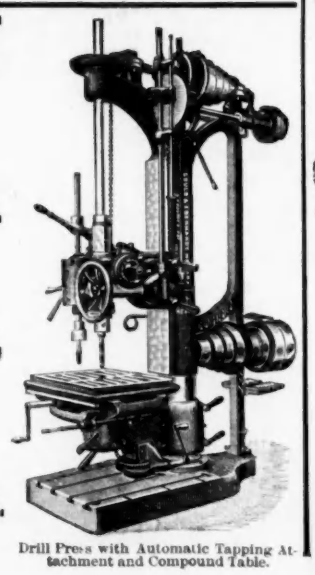

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